# SAN ANGELO STATE SUPPORTED LIVING CENTER

# EMERGENCY GENERATOR AND MECHANICAL SYSTEM UPGRADE

## Project No.

# 18-131-SGL (1)

11640 N. US HIGHWAY 87

CARLSBAD, TEXAS 76934

TEXAS
Health and Human Services

EMC
ENGINEERS

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100% CONSTRUCTION DOCUMENTS
VOLUME I
December 17, 2019

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# Project Directory

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# *Specifications 2*

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# SECTION 01 00 00 – SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SCOPE:

A. The work covered by this project consists of the Contractor furnishing all layout, survey, plant, labor, supervision, quality control, materials, equipment, machines, tools, appliances, services, supplies, and incidentals and of performing all operations in connection with the Emergency Generators and Mechanical System Upgrade at San Angelo State Supported Living Center, Texas, complete and in strict accordance with the plans and specifications.

B. The included edition of the Uniform General Conditions & Supplementary General Conditions (herein with referred to simply as the UGCs/SGCs) form a part of and are basic to these project specifications. Where ever in this specification the words “Owner” or “ODR” is used this shall be understood to be the State’s Owner’s Designated Representative, the word Facility is the Living Center’s Plant Maintenance Manager, and the word “Architect/Engineer”, “A/E” or “Design Professional” is the firm/individuals employed by and acting on behalf of the State to provide professional design services and contract administration of all technical aspects of this project.

PART 2 - WORKING CONDITIONS: Below is a brief general outline of work items:

2.0 FACILITY SPECIFIC WORKING CONDITIONS: Reference UGC Article 7 and Section 01 50 00-1.7.

2.1 The prime Contractor shall be a Mechanical/Electrical Contractor with a history of demonstrating successful completion of similar type work for at least five (5) years.

2.2 After the initial sixty five (65) calendar day set aside, the prime Contractor may work on as many different areas as desired at one time; however, once an area is started, work must be continuous, and it must be finished in a timely manner. Facility coordination is required.

2.3 The Contractor shall have a full-time superintendent on site whose primary responsibility is quality control and detailed coordination with the Facility whenever work is being performed by any Contractor or Sub Contractor at any tier level.

2.4 Construction activities shall not interrupt the ability of the existing emergency generators, chilled water, heating system, existing wells, water treatment plant (WTP) and or waste water treatment plant (WWTP), to operate, except for brief, scheduled shutdowns as needed.

2.5 Project Summary: New emergency generators will replace the existing generator systems at buildings 503, 514, 533, 607 and 752. The existing heating boiler plant will be upgraded with new boilers, pumps, piping and reconnection to the existing two (2) pipe distribution system. The existing chilled water system will have new cooling towers, pumps, isolation valves and piping to connect back into the existing two (2) pipe distribution system. All upgrades are not limited to, but include the following:

1. Demolition and removal of the existing generators, fencing and equipment pads. Provision for temporary generator power during switch over period.
2. Installation of new emergency generators, transfer switches (ATS) and emergency electrical panels with new equipment pads and fencing.
3. Demolition of the existing campus heating water plant system including boilers, pumps, piping and valves.
4. Installation of new heating water boilers, recirculation pumps, piping and supports, and valves with reconnection to two (2) pipe campus distribution system.
5. Demolition of existing chiller cooling towers, isolation valves, condenser pumps and piping associated with existing cooling towers.
6. A PLC and related controls will be integrated to work with the existing chilled water, condensing water, heating water, change-over valve systems.
7. Installation of ground mounted cooling towers (one for each existing chiller), on equipment pads, condenser pumps with piping and valves.
8. New chiller supply pumps, piping and isolation valves.
9. Renovate and refurbish existing concrete stack with new paint, lighting and warning lights.
10. Asbestos Abatement of existing abandoned steam boilers and removal of boiler after asbestos remediation including flue assembly to existing chimney.

PART 3 - WORK SCHEDULE:

A. Working hours for the Contractor will normally be between the hours of 8:00 a.m. and 5:00 p.m. excluding Saturdays, Sundays, and State holidays.

B. The contract performance time has been set at 430 calendar days to encompass the initial sixty five (65) day set aside period for submittal approvals plus one complete year (365 days) to encompass a complete cooling and heating season. Contractor shall schedule his work so as to maintain continued complete facility cooling/heating operation capabilities in appropriate season.

C. Project Outline:

1. After Notice to Proceeding:

Within the first sixty five (65) calendar days the Contractor shall perform the following tasks:

a) Submit and secure approval of all Shop Drawings per the Shop Drawing Log.
b) Order equipment.
c) Establish Contractor storage site.
d) Asbestos Abatement of steam boiler with removal of steam boiler itself.
e) No construction to take place during the period just site preparations.

2. After system change over to Cooling Season:

a) Removal of steam boiler and associated flue assembly to chimney.
b) Removal of existing heating water boiler plant and defined by the drawings including electrical power
c) Installation of new heating water boiler plant and defined by the drawings including electrical power
d) Installation of new ground mounted cooling tower with piping extended into chiller room for future connection to chillers including electrical power.
e) Staged replacement of primary (campus) pump coordinate such that one pump at all times including electrical power.
f) Begin replacement of valves as system allows and with coordination of plant maintenance manager.
g) Refurbishment and painting of chimney. Replacement and installation of chimney lighting.

3. Generator replacement concurrent work at any time after first sixty five (65) days:

a) Removal and replacement of emergency generator for building 503.
b) Removal and replacement of emergency generator for building 514.
c) Removal and replacement of emergency generator for building 533.
d) Removal and replacement of emergency generator for building 752.
e) Removal and replacement of emergency generator for building 607.

4. After Heating season change over:

a) Removal of existing chiller cooling towers including piping and electrical power.
b) Connect the new cooling towers to respective chiller coordinating campus seasonal change over.
c) Replacement of piping valves.
d) Replacement of change over valves to automated valves.
e) Updating energy management control system (EMCS) software and coordination new software updates and changes.

5. Substantial Completion

a) Project will have a single substantial completion inspection after completion of all work and if accepted will commence start of all warranties.

PART 4 - UTILITIES:

4.1 IDENTIFICATION: The Facility does not know the exact location of all utilities in the work area. The Contractor shall take reasonable precautions in determining the exact location of all existing utilities within the contract work area prior to any excavating, trenching, backfilling or disturbance. Upon request by the Contractor, the Facility will furnish all available information in its possession concerning utilities in the contract work area and assist the Contractor with location. However, the accuracy of the information provided by the Facility is not guaranteed and is only intended to provide some measure of assistance to the Contractor. In the event the Contractor identifies and/or uncovers unknown, un-shown utilities in the contract work area, which interfere with the newly proposed construction, the A/E and ODR shall be immediately notified for disposition. The Contractor shall furnish to the A/E red-lined as-built drawings clearly identifying the exact location of all utilities identified in the work area prior to project substantial completion inspection.

4.1.1 Any removal/relocation/reconnection of any communication or Cable TV device shall be coordinated in advance with the Facility. Communications and Cable TV devices to remain shall be protected as required when work proximity dictates. Contractor must exercise extreme caution and perform thorough coordination with the Facility when working around fiber and fiber networks to prevent damage as local resources are not available to make repairs.

4.2 INTERRUPTIONS: Planned Utility Outages: The Contractor shall coordinate all requests for utility outages with the Facility seven (7) calendar days prior to date of requested outage. Water, gas, sewer and electrical outages shall be held to a maximum duration of two (2) hours unless otherwise approved in writing.

4.2.1 Unplanned Utility Outages (Accidental Disruption of Utilities): In the event of accidental disruption of any utility, the Contractor shall immediately notify the Facility of the unplanned outage. The Contractor shall immediately take every reasonable step to repair the damage in a manner acceptable to the Owner and shall restore the utility to full use as soon as practicable.

4.2.2 For all drinking water disruptions, the Contractor shall adhere to 30 TAC 290 Subchapter D paragraph 290.46(g). Submit a “Drinking Water Customer Service Inspection Checklist” prior to restoring drinking water service.

4.3 USE AND AVAILABILITY: All reasonable quantities of existing utilities will be made available to the Contractor without charge. Proposed temporary connections must be coordinated with the Facility in advance of any connection. Any temporary connections or lines required shall be installed, maintained, and removed at the Contractor’s expense. Any damage associated with the use of these utilities shall be repaired and/or replaced in a manner satisfactory to the Owner at the Contractor's expense. Contractor shall always strive to conserve the electric, natural gas and water utilities at the Facility.

4.3.1 Prior to using any fire hydrant on the Facility, the Contractor must first request and coordinate, then furnish and install an approved Class III Back Flow Preventer (reduced pressure principle device) and screw type globe valve to be attached to the hydrant. The backflow device and valve shall be properly supported to prevent damage to fire hydrant threads.

PART 5 - SAFETY AND HEALTH: See Article 7 of the UGCs/SGCs.

5.1 All Contractor operations shall be conducted and performed in accordance with Department of Labor, OSHA requirements found in 29 CFR 1910 and 29 CFR 1926. The Contractor shall comply with all mandatory requirements for lockout/tag out, hazard communication, fall protection, personnel protection equipment, scaffolding, powered construction equipment, and all project related safety and health requirements.

5.2 All companies who conduct business within the State of Texas must, in accordance with Texas Worker's Compensation laws (Texas House Bill 62), have an approved company safety policy and an Accident Prevention Plan. The plan, approved by the Texas Worker's Compensation Commission (TWCC), shall be submitted with the mobilization submittal (see Section 01300 of these specifications).

5.3 Welding, Cutting and Brazing: The Contractor shall provide the appropriate operable fire extinguisher. Fire extinguishers shall comply with NFPA 10. Contractor shall comply with OSHA STD29 CFR 1910.252 Welding, Cutting and Brazing (General Requirements).

5.4 Infection Control: Refer to the UGCs/SGCs Article 7. The Contractor shall complete the Infection Control Permit for this project and submit with his mobilization submittal.

5.4.1 It has been determined that Type C, Low Risk applies, requiring class II construction control procedures.

5.5 Asbestos Containing Materials (ACM): Refer to paragraph eleven (11) of the Invitation and Instructions to Bidders for information concerning ACM.

5.5.1 All holes/pits/trenches/manway openings, etc., that are permitted to be left open overnight shall be surrounded with a 48-inch high mesh fence with highly visible orange plastic coating with warning signs posted "Keep Out". Guardrails, fences, barricades and warning lights or other illumination shall be provided in roadwork construction or near vehicular traffic areas. Fence shall be securely anchored with tension wires and posts as required to prevent sagging and located a minimum of three (3) feet from the opening so as to prevent an individual, should they fall across the fencing, from falling into the opening. Holes shall also be covered, when not being worked in, with three quarter inch

plywood or a metal grating that will prevent clients from entering the hole. See Article 7 of the UGCs.

PART 6 - DISPOSITION OF WASTE, SALVAGE AND EXCESS MATERIALS:

6.1 The Contractor shall make waste determinations for all wastes generated in the performance of this contract, in accordance with the provisions set out in 40 Code of Federal Register (CFR) Part 261, at the time and point of generation. The Contractor shall properly sample, analyze, or by use of process knowledge classify all wastes in accordance with Title 30 Texas Administrative Code (TAC), Chapter 335, Subchapter R at no additional cost to the Owner. All non-hazardous wastes, special wastes, and hazardous wastes (including but not limited to construction debris, material containers, material residues and unwanted excess materials) resulting from the performance of work under this contract shall be removed from and disposed of off State property by the Contractor at no additional cost to the Owner and in accordance with all applicable Federal, State, and local laws, rules and regulations. Under no circumstances shall the Contractor dispose of wastes or excess material in trash dumpsters, storm sewers, sanitary sewers, creeks, streams or other property of the State.

6.2. Dumping/cleaning out of concrete trucks on State property is prohibited. Concrete truck chutes only may be rinsed at the construction site. Wastewater and concrete from this rinse shall be collected in a high-density polyethylene (HDPE) plastic-lined box or pit provided by the Contractor at the site. At the end of pouring operations, the Contractor shall excavate all the waste and liner and properly dispose of same. The pit shall be completely backfilled, and the site restored to original conditions.

6.3. Recycling is highly encouraged and shall be employed to the maximum extent practicable.

6.4 All equipment and materials to be removed from the project site not specifically identified for turn-in to the Owner shall become the property of the Contractor upon issuance of the NTP. The Contractor shall turn-in all materials specifically designated for turn-in to the Owner to a location as designated by the Facility. The Contractor shall following salvage: one (1) generator designated by Facility at pre-construction conference back to the facility.

PART 7 - TESTING:

7.1 Costs of all tests, both those as listed and those as required by referenced Codes, shall be provided by and at the Contractor's expense, unless specifically indicated as being performed by the Owner elsewhere in the contract documents. The Contractor shall schedule all tests and notify the ODR, the A/E, and the Facility in advance in a timely manner prior to any required testing. At times, Code Compliance Officers from within the ODR's organization; but located in other areas of the State, are required to witness such tests and timely notices and coordination

are paramount to their schedules. All test results shall be submitted with the closeout documents.

7.1. FINAL INSPECTIONS:

A. The Contractor's attention is directed to Article 12 of the UGCs/SGCs for a comprehensive discussion of the requirements for scheduling, performing and completing the "Substantial", "Final", and "Inspection of Completed Final" punch list items.

END OF SECTION 01 00 00

## SECTION 01 30 00 – SUBMITTALS, SHOP DRAWINGS/SAMPLES & SCHEDULES

PART 1 – GENERAL

1.1 REFERENCES:

A. Refer to Article 9 of the UGCs/SGCs for detailed requirements on the Construction Progress Schedule. Refer to Article 8.3 Submittals of the UGCs/SGCs for detailed requirements for the Shop Drawing Log/Submittal Schedule & Register and technical shop drawings submittals. Refer to Article 10.1 of the UGCs/SGCs for detailed requirements on the preparation of the Schedule of Values.

1.2. MOBILIZATION SUBMITTAL REQUIREMENTS:

A. The following items are required to be submitted and approved before the Contractor can commence actual on site work (except for minor field measurements and survey):

1) A company organization chart fully outlining employees' title, duties and responsibilities, and contact information including a 24/7 cell phone number for the designated overall on- site construction superintendent. Persons with full signature authority to act upon the Contractor's behalf shall be identified.
2) A list of major sub-contractors and suppliers complete with point of contact information and full addresses.
3) Equal Employment Opportunity letters
4) Copy of any certifications required by these specifications
5) A brief mobilization plan outlining exactly when Contractor proposes to commence actual on site work, how large an area in the common storage area he proposes for his and sub-contractors use, and any other required Facility coordination items
6) A phasing/sequencing plan briefly outlining the order/times the Contractor proposes to accomplish the work in
7) A Safety Plan (See UGC/SGC Article 7.1 and Section 01000-5.2 of these specifications)
8) Infection Control Permit (See UGC/SGC Article 7.8 and Section 01 00 00, paragraph 5.4).

1.3 SUBMITTALS (BIG THREE) REQUIRED TO BE APPROVED PRIOR TO INITIAL PAY VOUCHER MEETING:

A. Ideally, the following three submittals should also be included with the Mobilization Submittal. In any event, they must be approved prior to the first voucher meeting being scheduled.

1) Progress Schedule. NOTE: The requirement for a Critical Path method work progress schedule outlined in Article 9.3 of the UGCs/SGCs is **not** required for this

project. Utilize a progress schedule in the format contained in the adjoining pages of this Section. Contractor's attention is directed to Article 9.4 and the requirement to utilize 10 percent float in the schedule. This progress schedule shall be updated monthly by the Contractor and submitted with each of the Contractor's pay vouchers.

2) A Schedule of Values (SOV). Use exactly the format provided up front in these specifications Bidding Requirements and as also to be provided on disc at the pre-construction conference. The approved SOV shall be submitted monthly by the Contractor with each of his pay vouchers.

3) A Shop Drawing Log/Submittal Register in the format contained in the adjoining pages of this Section.

1.4. TECHNICAL SUBMITTALS & SHOP DRAWINGS / SAMPLES (Note: Technical submittals will not be reviewed/approved until mobilization and Big Three submittals are approved):

A. The following are required:

1) To the maximum extent practicable, all technical submittals shall be submitted concurrently or as close together as possible and shall be provided as soon as possible, early on in the project. Submittals involving colors and interior design shall all be transmitted concurrently.
2) Items such as mill certificates or other test data that are usually unavailable until the equipment/material is actually manufactured/fabricated shall still be identified on the log. An explanation stating this data shall be submitted later by Submittal Number (fill in Submission Number) after materials are manufactured/fabricated (or other explanations as appropriate) shall be included with this identification. A separate submittal for long lead-time equipment or material may be made if sufficient data is furnished to show contract compliance. (An explanation shall be provided on a separate sheet, if necessary, explaining why a partial submittal is being made. Explanation shall include the estimated delivery date of the equipment/ material and the Submission Number of the submittal that shall contain data required by the particular specification section for the remaining equipment/materials.) Samples of materials, where required, must be submitted along with technical data, not under separate transmittals.
3) Any submittal annotated by a supplier/vendor with "Field Verify," "Select Color," and the like must be accompanied by the Contractor's written response to the supplier's query.

5. CONTRACTOR REPORTS:

A. The Contractor shall provide weekly progress reports on all construction activities including every sub-contractor tier level. These reports shall include as a minimum weather conditions with precipitation levels and temperature high and lows, numbers and type of personnel on sight, activities worked on and completed, instructions received from the A/E or ODR or Facility, service disruptions, test results, system start-ups, accidents, and other pertinent information as directed by the A/E. These reports shall be transmitted bi-weekly to the A/E, ODR, and Facility electronically via email (.pdf)

files.

END OF SECTION 01 30 00

1. PROJECT NUMBER: **18-131- SGL (1)**

TITLE: **Emergency Generators and Mechanical System Upgrade**

LOCATION: **San Angelo SSLC**

2. WORK ORDER DATE:

3. COMPLETION DATE:

4. APPROVED TIME EXTENSION:

5. AMENDED COMPLETION DATE

# CONTRACT PROGRESS SCHEDULE

MAINTENANCE & CONSTRUCTION SECTION

TEXAS DEPARTMENT OF MENTAL HEALTH AND MENTAL RETARDATION

P. O. BOX 12668, AUSTIN, TEXAS 78711 512-206-5880

6. SUBMITTED BY: **EMC Engineers**

DATE

7. CONTRACTOR'S NAME, ADDRESS, ZIP, PHONE, SIGNATURE

8. APPROVAL RECOMMENDED BY:

DATE

ARCHITECT/ENGINEER (SIGNATURE)

9. APPROVED BY

DATE

PROJECT MANAGER (SIGNATURE)

| ITEM NO | WORK ELEMENTS | % | MONTHS | | | | | | | | | | | | | | |
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**INSTRUCTIONS TO CONTRACTORS**

1. Prepare Contract Progress Schedule in accordance with these instructions and submit to the Project Manager at the time stated in the Contract or as established by the Project Manager.
2. Block 1 – Enter the Project Number, Title, and Location as shown on the Contract.
3. Blocks 2 & 3 – Enter the Work Order Date and Completion Date as specified by the Project Manager in the Work Order letter executing the time period specified in the Contract.
4. Blocks 4 & 5 – Enter the Calendar Days of Time Extensions and amended Completion Date when applicable as specified in Change Orders.
5. Blocks 6 & 7 – Enter the Name and Address of your Firm. The Schedule must be dated and signed by the Contractor or an authorized representative of the Firm.
6. Block 8 – Schedule should be approved by the Commissioned Architect or Engineer supervising the project.
7. Block 9 – Schedule should receive final approval by signature of the Project Manager for final authorized acceptance.
8. Each major work element is to be sequentially numbered and continued on additional pages if needed. Major elements of work, such as excavation, concrete work, carpentry, masonry, paint, mechanical, electrical, Alternate 1, Alternate 2, etc., will be shown in the Work Element Column in logical sequence and in sufficient detail to identify each element.
9. The percentage of each listed work element to the complete job will be shown opposite each element in the % column. For example, if three work elements are shown: excavation, concrete work, and backfill, and it is estimated that excavation is 50% of the total job, concrete 30%, and backfill 20%, these percentages will be shown opposite each element. The total must be 100%. Indicate the percentage graphically by means of a bar graph, within the second horizontal line under months.

**SHOP DRAWING LOG / SUBMITTAL SCHEDULE & REGISTER**: PROJECT NO. : **18-131-SGL (1)** PROJECT NAME: **San Angelo SSLC Emergency Generators & Mechanical System Upgrade**

| SUBMITTAL NUMBER (# by Contractor) | SPEC SECTION & DESCRIPTION | REC'D FROM CONRACTOR | RETURNED TO CONTRACTOR | ACTION | | |
|---|---|---|---|---|---|---|
| | | | | APPROVED | APP. AS NOTED | REJECTED |
| | **013000 MOBILIZATION ITEMS:** 2.1: Organization Chart, responsibilities / contact info | | | | | |
| | " " 2.2: List of major subs & suppliers (from HSP) | | | | | |
| | " " 2.3: EEO Letters from Prime & subs | | | | | |
| | " " 2.4: Licenses & certifications | | | | | |
| | " " 2.5: Mobilization Plan approved by Facility PPM | | | | | |
| | " " 2.6: Detailed phasing work schedule/sequence of work | | | | | |
| | " " 2.7: Safety Plan<br>" " 2.8: Infection Control Permit | | | | | |
| | **APPROVAL REQ'D PRIOR TO 1ST VOUCHER MTG:**013000-3.1: Progress Schedule | | | | | |
| | " " 3.2: Detailed Schedule of Values | | | | | |
| | " " 3.3: & UGCs 8.3.1.1: This Submittal Schedule w/ proposed numbers consecutively | | | | | |
| | 03 01 30 Concrete Rehabilitation – Concrete Epoxy Job Formula | | | | | |
| | 03 30 00 Concrete Cast In Place – Concrete Testing | | | | | |
| | 09 91 13 Exterior Painting – Color Samples | | | | | |
| | 22 05 00 General Mechanical Requirements | | | | | |
| | 22 05 13 Basic Mechanical Materials and Methods | | | | | |
| | 22 11 16 Plumbing Piping – Piping Material, Solder, Fittings | | | | | |
| | 23 05 13 Motors | | | | | |
| | 23 05 53 Mechanical Identification | | | | | |
| | 23 05 93 Testing, Adjusting and Balancing Qualifications and Final Report | | | | | |
| | 23 06 20 Hydronic Specialties - Valves, Strainers, Accessories, Hanger Supports | | | | | |
| | 23 07 19 Hydronic Piping Insulation | | | | | |
| | *23 09 23 Energy Management Control System – Sequence of Operations, Points List, Ladder, Diagram Valve | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 23 21 13 Hydronic Piping – Piping, Fittings, Accessories, Hangers, Supports | | | | | |
| | 23 21 23 HVAC Pumps - Pumps | | | | | |
| | *23 52 34 Heating Water Boilers - Boilers | | | | | |
| | *23 65 00 Packaged Cooling Tower – Cooling Towers | | | | | |
| | 26 05 00 Electrical General Provisions | | | | | |
| | 26 05 10 Basic Electrical Materials & Methods | | | | | |
| | 26 05 11 Minor Electrical Demolition | | | | | |
| | 26 05 19 Building Wire and Cable | | | | | |
| | 26 05 26 Grounding and Bonding | | | | | |
| | 26 05 29 Supporting Devices | | | | | |
| | 26 05 33 Conduit | | | | | |
| | 26 05 34 Boxes | | | | | |
| | 26 05 53 Electrical Identification | | | | | |
| | 26 05 63 Equipment Wiring Systems | | | | | |
| | 26 24 16 Panelboards | | | | | |
| | 26 27 16 Cabinets and Enclosures | | | | | |
| | 26 27 26 Wiring Devices | | | | | |
| | 26 28 19 Enclosed Switches | | | | | |
| | *26 32 13 Package Engine Generator Systems – Generation ATS | | | | | |
| | 26 56 00 Exterior LED Luminaires – Light Fixtures | | | | | |
| | *26 92 23 Variable Frequency Controllers - Controller | | | | | |
| | 32 31 13 Chain Link Fences and Gates | | | | | |
| | For Shop Drawing Submittals marked with an * above the Contractor shall provide two (2) hard copies of these submittals. One (1) set are going to Michael Schultz, P.E. and one (1) set to Perry Havard for Owner Review in addition to electronic copies to AE.. | | | | | |
| | | | | | | |
| | 02 82 00 Asbestos Remediation | | | | | |
| | Contractor Qualifications | | | | | |
| | Contractors - Personnel Qualifications | | | | | |
| | Contractor Submittals | | | | | |
| | Contractor's Responsibilities | | | | | |

## Section 01 40 00 Reference Standards and Codes

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings Uniform General Conditions and Supplementary General Conditions, Supplementary Conditions and Division 1 - General Requirements apply to Work of this Section.

1.2. SECTION INCLUDES:

A. Quality assurance.

B. Schedule of references.

1.3. QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or other consensus standards; comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids.

C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect/Engineer and Owner before proceeding.

D. The contractual relationship duties and responsibilities of the parties in Contract nor those of the Architect/Engineer shall not be altered from the Contract Documents by mention or inference otherwise in any reference

document.

## 1.4. SCHEDULE OF REFERENCES

| | | |
|---|---|---|
| AA | Aluminum Association<br>900 19th St., NW<br>Washington, DC 20006<br>www.aluminum.org | (202) 862-5100 |
| AABC | Associated Air Balance Council<br>(202) 737-0202<br>1518 K St., NW<br>Washington, DC 20005<br>www.aabchq.com | |
| AAMA | American Architectural Manufacturers Association<br>1827 Walden Office Sq., Suite 104<br>Schaumburg, IL 60173-4268<br>www.aamanet.org | (847) 303-5664 |
| AASHTO | American Association of State Highway and Transportation Officials<br>444 North Capitol Street, N.W., Suite 249<br>Washington, DC 20001<br>www.ashto.org | |
| AATCC | American Association of Textile Chemists and Colorists<br>1 Davis Dr,<br>Research Triangle Park<br>Durham, N.C. 27709<br>www.aatcc.org | 919-549-8141 |
| ABMA | American Boiler Manufacturers Association<br>950 N. Glebe Rd., Suite 160<br>Arlington, VA 22203-1824 | |

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|---|---|---|
| ACI | American Concrete Institute<br>P.O. Box 9094<br>Farmington Hills, MI 48333-9094<br>www.aci-int.org | |
| ACI | ACI International<br>P.O. Box 9094<br>Farmington Hills, MI 48333-9094 | |
| ADA | Americans with Disabilities Act of 2010 (Fed P.L. 101-336) | |
| ADC | Air Diffusion Council<br>104 So. Michigan Ave., No. 1500<br>Chicago, IL 60603 | |
| ADSC | The International Association of Foundation Drilling<br>9696 Skillman Street, Suite 280<br>Dallas, TX 75243<br>www.adsc-iafd.com | (214) 681-5994 |
| AF&PA | American Forest & Paper Association<br>1111 Nineteenth St. NW, Suite 800<br>Washington, DC 20036<br>www.afandpa.org | (202) 463-2700 |
| AGA | American Gas Association<br>P.O. Box 79230.<br>Baltimore, MD 21279-0230 | |
| AGC | Associated General Contractors of America<br>1957 E Street, N.W.<br>Washington, DC 20006 | |
| AHA | American Hardboard Association<br>1210 W. Northwest Hwy<br>Palatine, IL 60067<br>www.hardboard.org | (847) 934-8800 |
| AI | Asphalt Institute<br>Research Park Drive<br>P.O. Box 14052<br>Lexington, KY 40512-4052<br>www.asphaltinstitute.org | (606) 288-4960 |

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|---|---|---|
| AIA | American Institute of Architects<br>1735 New York Avenue, N.W.<br>Washington, DC 20006 | |
| AISC | American Institute of Steel Construction<br>One East Wacker Dr., Suite 3100<br>Chicago, IL 60601-2001<br>www.aisc.org | (312) 670-2400 |
| AISI | American Iron and Steel Institute<br>1101 17th St., NW, Suite 1300<br>Washington, DC 20036<br>www.steel.org | (202) 452-7100<br>(800) 277-3850 |
| AITC | American Institute of Timber Construction<br>7012 S. Revere Pkwy, Suite 140<br>Englewood, CO 80112<br>www.aitc-glulam.org | (303) 792-9559 |
| AMCA | Air Movement and Control Association International, Inc.<br>30 W. University Dr.<br>Arlington Heights, IL 60004-1893<br>www.amca.org | (847) 394-0150 |
| ANSI | American National Standards Institute<br>1819 L. Street, N.W.<br>Washington, DC 20036<br>www.ansi.org | (202) 293-8020 |
| APA/EWA | APA-The Engineered Wood Association<br>P.O. Box 11700<br>Tacoma, WA 98411-0700<br>www.apawood.org | (253) 565-6600 |
| API | American Petroleum Institute<br>1220 L St., NW<br>Washington, DC 20005-4070<br>www.api.org | (202) 682-8000 |
| ARI | Air-Conditioning and Refrigeration Institute<br>4301 North Fairfax Dr., Suite 425<br>Arlington, VA 22203<br>www.ari.org | (703) 524-8800 |

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|---|---|---|
| ARRA | Asphalt Recycling and Reclaiming Association<br>#3 Church Circle, PMB 250<br>Annapolis, MD 21401<br>www.arra.org | (410) 267-0023 |
| ASCE | American Society of Civil Engineers<br>World Headquarters<br>1801 Alexander Graham Bell Dr.<br>Reston, VA 20191-4400<br>www.asce.org | (703) 295-6300<br>(800) 548-2723 |
| ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers<br>1791 Tullie Circle, N.E.<br>Atlanta, GA 30329<br>www.ashrae.org | (800) 527-4723<br>(404) 636-8400 |
| ASME | American Society of Mechanical Engineers<br>3 Park Avenue<br>New York, NY 10016-5990<br>www.asme.org | (800) 843-2763 |
| ASPA | American Sod Producers Association<br>4415 West Harrison Street<br>Hillside, IL 60162 | |
| ASPE | American Society of Plumbing Engineers<br>15233 Ventura Blvd., Suite 811<br>Sherman Oaks, CA 91403 | |
| ASTM | American Society for Testing and Materials<br>100 Barr Harbor Dr.<br>West Conshohocken, PA 19428-2959<br>www.astm.org | (601) 832-9585 |
| AWI | Architectural Woodwork Institute<br>1952 Isaac Newton Sq. West<br>Reston, VA 20190<br>www.awinet.org | (703) 733-0600 |
| AWPA | American Wood-Preservers' Association<br>P.O. Box 5690<br>Grandbury, TX 76049-7979<br>www.awpa.com | (817) 326-6300 |

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|---|---|---|
| AWS | American Welding Society<br>550 LeJeune Road, N.W.<br>Miami, FL 33126<br>www.amweld.org | (800) 443-9353<br>(305) 443-9353 |
| AWWA | American Water Works Association<br>6666 West Quincy Avenue<br>Denver, CO 80235<br>www.awwa.org | (303) 794-7711 |
| BHMA | Builders' Hardware Manufacturer Association<br>355 Lexington Avenue, 17th floor<br>New York, NY 10017<br>www.buildershardware.com | (212) 297-2122 |
| BOCA | Building Officials and Code Administrators International, Inc | |
| BIA | The Brick Industry Association<br>11490 Commerce Park Drive<br>Reston, VA 28191-1525<br>www.bia.org | (703) 620-0010 |
| CABO | Council of American Building Officials; One & Two Family Dwelling Code and the Model Energy Code | |
| CDA | Copper Development Association<br>57th Floor, Chrysler Building<br>405 Lexington Avenue<br>New York, NY 10174 | |
| CFR | Code of Federal Regulations<br>North Capitol Street between G & H Streets, NW<br>Washington, DC 20402 | |
| CLFMI | Chain Link Fence Manufacturers Institute<br>1101 Connecticut Avenue, N.W.<br>Washington, DC 20036 | |
| CPSC | Consumer Product Safety Commission<br>1111 Eighteenth Street, NW<br>Washington, DC 20207 | |

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| CRSI | Concrete Reinforcing Steel Institute<br>933 Plum Grove Road<br>Schaumburg, IL 60195 |
| DHI | Door and Hardware Institute<br>7711 Old Springhouse Road<br>McLean, VA 22102 |
| DOT | Department of Transportation<br>400 Seventh Street, SW<br>Washington, DC 20590 |
| EJCDC | Engineers' Joint Contract Documents Committee<br>American Consulting Engineers Council<br>1015 15th Street, N.W.<br>Washington, DC 20005 |
| EJMA | Expansion Joint Manufacturers Association<br>25 North Broadway<br>Tarrytown, NY 10591 |
| EPA | Environmental Protection Agency<br>401 M Street, SW<br>Washington, DC 20460 |
| FCC | Federal Communications Commission<br>1919 M Street, NW<br>Washington, DC 20554 |
| FM | Factory Mutual System<br>1151 Boston-Providence Turnpike<br>P.O. Box 688<br>Norwood, MA 02062 |
| FS | Federal Specification<br>General Services Administration<br>Specifications and Consumer Information<br>Distribution Section (WFSIS)<br>Washington Navy Yard, Bldg. 197<br>Washington, DC 20407 |
| GA | Gypsum Association<br>810 First St. NE, Suite 510<br>Washington, DC 20002 |

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| GANA | Glass Association of North America<br>2945 SW Wanamaker Drive, Suite A<br>Topeka, KS | (785) 271-0208 |
| HPMA | Hardwood Plywood Manufacturers Association<br>1825 Michael Faraday Drive<br>P.O. Box 2789 | |
| HPW | H.P. White Laboratory<br>3114 Scarboro Road<br>Street, MD 21154<br>Reston, VA 22090-2789 | |
| ICBO | International Conference of Building Officials<br>5360 S. Workman Mill Road<br>Whittier, CA 90601 | |
| ICF ID/RC | Intermediate Care Facilities for Individuals with Intellectual Disability or Related Conditions<br>Texas Administrative Code, Title 40, Part 1, Chapter 90, Subchapter D, General requirements for Facility Construction, applicable to facilities certified by the Department of Aging and Disability Services (DADS) Regulatory Services | |
| IEEE | Institute of Electrical and Electronics Engineers<br>345 East 47th Street<br>New York, NY 10017 | |
| IES | Illumination Engineering Society of North America<br>345 East 47th Street<br>New York, NY 10017 | |
| IMIAC | International Masonry Industry All-Weather Council<br>International Masonry Institute<br>815 15th Street, N.W.<br>Washington, DC 20005 | |
| IMSA | International Municipal Signal Association165 East Union Street<br>P.O. Box 539<br>Newark, NY 14513 | |

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|---|---|---|
| ISWA | Insect Screen Weavers Association<br>P.O. Box 1018<br>Ossining NY 10562 | |
| JCAHO | Joint Commission on Accreditation of Health Care Organizations | |
| MBMA | Metal Building Manufacturer's Association<br>1300 Sumner Avenue<br>Cleveland, OH 44115-2851 | |
| MFMA | Maple Flooring Manufacturers Association<br>60 Rivere Drive, Suite 500<br>Northbrook, IL 60062<br>mfma@maplefloor.com | (847) 480-9138 |
| MIL | Military Specification<br>Naval Publications and Forms Center<br>5801 Tabor Avenue<br>Philadelphia, PA 19120 | |
| ML/SFA | Metal Lath/Steel Framing Association<br>221 North LaSalle Street<br>Chicago, IL 60601 | |
| NAAMM | National Association of Architectural Metal Manufacturers<br>221 North LaSalle Street<br>Chicago, IL 60601 | |
| NBS | National Bureau of Standards<br>(U.S. Department of Commerce)<br>Gaithersburg, MD 20234 | |
| NCMA | National Concrete Masonry Association<br>P.O. Box 781<br>Herndon, VA 22070 | |
| NCRP | National Council on Radiation Protection and Measurement<br>7910 Woodmont Ave, Suite 800<br>Bethesda, MD 20814 | |
| NCSBCS | National Conference of States on Building Codes and Standards | |

NEBB National Environmental Balancing Bureau
8224 Old Courthouse Road
Vienna, VA 22180

NEC National Electrical Code (by NFPA)

NECA National Electrical Contractors Association
7315 Wisconsin Avenue
Bethesda, MD 20814

NEMA National Electrical Manufacturers' Association
2101 'L' Street, N.W.
Washington, DC 20037

NFPA National Fire Protection Association
Battery March Park
Quincy, MA 02269

The chart below outlines the commonly referenced applicable National Fire Codes. Other specific National Fire Codes may be applicable.

| Code | Title of NFPA Standard |
|---|---|
| 1 | Fire Code |
| 10 | Portable Fire Extinguishers |
| 13 | Installation of Sprinkler Systems |
| 13D | Installation of Sprinkler Systems in one- and Two-Family Dwellings |
| 13R | Installation of Sprinkler Systems in Residential Occupancies up to and including (4) Four Stories in Height |
| 14 | Installation of Standpipe and Hose Systems |
| 17 | Dry Chemical Extinguishing Systems |
| 17A | Wet Chemical Extinguishing Systems |
| 25 | Inspection, Testing, and Maintenance of |
| 30 | Water-Based Fire Protection Systems |
| 54 | Flammable and Combustible Liquids |
| 58 | Code |
| 70 | National Fuel Gas Code |
| 72 | Liquefied Petroleum Gas Code |
| 80 | National Electrical Code |
| 90A | Fire Doors and Other Opening Protectives |
| 90B | Installation of Air Conditioning and Ventilating Systems |
| 91 | Installation of Warm Air Heating and Air Conditioning Systems |
| 96 | Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids |
| 99 | Ventilation Control and Fire Protection |
| 101 | of Commercial Cooking Operations |
| 101 | Health Care Facilities |
| A | Life Safety Code |
| 105 | Guide on Alternative Approaches to Life Safety |
| 110 | Smoke Door Assemblies and Other |
| 220 | Opening Protectives |
| 241 | Emergency and Standby Power |

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| | Systems<br>Types of Building Construction<br>Safeguarding Construction, Alteration and Demolition Operations |

NFoPA National Forest Products Association
1619 Massachusetts Avenue, N.W.
Washington, DC 20036

NHLA National Hardwood Lumber Association
P.O. Box 34518
Memphis, TN 38135

NPCA National Paint and Coating Association
1500 Rhode Island Avenue N.W.
Washington, D.C. 20005

NRCA National Roofing Contractors Association
8600 Bryn Mawr Avenue
Chicago, IL 60631

NSF National Sanitation Foundation
3475 Plymouth Road
P.O. Box 1468
Ann Arbor, MI 47106

NSWMA National Solid Wastes Management Association
1730 Rhode Island Ave., N.W.
Washington, DC 20036

NTMA National Terrazzo and Mosaic Association
3166 Des Plaines Avenue
Des Plaines, IL 60018

NWWDA National Wood Window & Door Manufacturers Association
205 W. Touhy Avenue
Park Ridge, IL 60068

OSHA Occupational Safety and Health Administration
(U.S. Department of Labor)
Government Printing Office
Washington, D.C. 20402
29 CFR 1910

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|---|---|
| PCA | Portland Cement Association<br>5420 Old Orchard Road<br>Skokie, IL 60077 |
| PCI | Prestressed Concrete Institute<br>201 North Wells Street<br>Chicago, IL 60606 |
| PS | Product Standard<br>U. S. Department of Commerce<br>Washington, DC 20203 |
| RILEM | International Union of Testing and Research Laboratories for Materials and Structures<br>RILEM Secretariat General<br>ENS-Pavillon des Jardins, 61 avenue du President Wilson<br>F-94235 Cachan Cedex, France |
| RIS | Redwood Inspection Service<br>One Lombard Street<br>San Francisco, CA 94111 |
| RCSHSB | Red Cedar Shingle and Handsplit Shake Bureau<br>515 116th Avenue<br>Bellevue, WA 98004 |
| RMA | Rubber Manufacturer's Association<br>1400 K Street, N.W.<br>Washington, D.C. 20005 |
| SDI | Steel Deck Institute<br>P.O. Box 9506<br>Canton, OH 44711 |
| S.D.I. | Steel Door Institute<br>712 Lakewood Center North<br>14600 Detroit Avenue<br>Cleveland, OH 44107 |
| SGCC | Safety Glazing Certification Council<br>Route 11, Industrial Park<br>Cortland, NY 13045 |

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|---|---|---|
| SIGMA | Sealed Insulating Glass Manufacturers Association<br>401 North Michigan Avenue<br>Chicago, IL 60611 | (312) 644-6610 |
| SJI | Steel Joist Institute<br>1205 48th Avenue North, Suite A<br>Myrtle Beach, SC 29577 | |
| SMACNA | Sheet Metal and Air Conditioning Contractors' National Association<br>8224 Old Court House Road<br>Vienna, VA 22180 | |
| SPIB | Southern Pine Inspection Bureau<br>4709 Scenic Highway<br>Pensacola, FL 32504-9094 | |
| SSPC | Steel Structures Painting Council<br>4400 Fifth Avenue<br>Pittsburgh, PA 15213 | |
| TAS | Texas Accessibility Standards Act of 2012 | |
| TDHS | Texas Department of Human Services: Licensing Standards for Intermediate Care Facilities Serving persons with Mental Retardation or a Related Condition (ICF-MR) | |
| TCA | Tile Council of America, Inc.<br>Box 326<br>Princeton, NJ 08540 | |
| UBC | Uniform Building Code | |
| UL | Underwriters' Laboratories, Inc.<br>333 Pfingston Road<br>Northbrook, IL 60062 | |

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|---|---|
| UMC | Uniform Mechanical Code |
| UPC | Uniform Plumbing Code |
| WCLIB | West Coast Lumber Inspection Bureau<br>6980 S.W. Varns Road<br>Box 23145<br>Portland, OR 97223 |
| WRI | Wire Reinforcement Institute<br>8361 A Greensboro Drive<br>McLean, VA 22102 |
| WWPA | Western Wood Products Association<br>1500 Yeon Building<br>Portland, OR 97204 |
| W.W.P.A. | Woven Wire Products Association<br>2515 N. Nordica Avenue<br>Chicago, IL 60635 |

PART 1 - PRODUCTS

Not Used

PART 2 - EXECUTION

Not Used

END OF SECTION 01 40 00

## SECTION 01 50 00 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 STORAGE AREA (I.E. TEMPORARY FIELD OFFICE, STAGING AREAS, TOOL/JOB SHACKS, AND OTHER CONSTRUCTION FACILITIES):

A. There are no State furnished covered or secure storage areas. Limited on campus, off-site storage may be permitted at the discretion of the Facility and on a space available basis. The plans show the general location of the Contractor storage area for this project. Utilities at the storage area may or may not be available for Contractor use. The Owner implies no responsibility for lost or stolen materials, equipment or tools, the security of which lies solely with the Contractor. Contractor shall keep his storage areas clean, neat and orderly and shall keep grass mowed to a maximum height of 4 inches. Temporary fencing used by the Contractor to delineate construction sites shall be securely anchored with tension wires and posts as required to prevent sagging and an unsightly appearance. Fencing shall be maintained by the Contractor in this manner throughout the life of the contract. Due to high winds in west Texas, Contractor shall take every precaution to preclude trash from blowing off site.

B. Contractor shall post at the job site on a bulletin board or other suitable surface the provided Rules & Regulations, as well as wage rates, job site Points of Contact, and other relevant project information.

1.2 TOILET FACILITIES:

A. There are no toilet facilities available for Contractor use. Contractor shall provide his own portable/temporary toilet facilities at specified storage area.

1.3 IDENTIFICATION OF CONTRACTOR VEHICLES:

A. Contractor vehicles shall be marked on each side with company name with either permanent or semi-permanent/magnetic signage to aide in identifying them.

1.4 STREET CLOSINGS:

A. When road closures are required notification must be made to the Facility a minimum of seven (7) days in advance. One lane of traffic shall be maintained at all times unless otherwise approved by the Facility.

B. The final street repair shall be completed within fourteen (14) days after the start of any street demolition for utility crossings or other purposes. Any part of the street returned to service prior to final repair shall be maintained smooth with compacted aggregate base course or cold-lay surface course.

1.5 CLEAN-UP:

A. The Contractor shall at all times keep the construction site and storage area(s) free from accumulation of waste, rubbish, weeds, overgrown grass or construction debris. All loose or light-weight materials shall be secured to prevent blowing or scattering. The burning of trash or construction debris is strictly prohibited. Prior to final inspection, the Contractor shall remove all construction debris, tools, equipment, and materials not the property of the State. Upon completion of the work, the Contractor shall leave the work site and storage area(s) in a clean, neat and workmanlike condition satisfactory to the Facility.

1.6 SECURITY AND CLIENT PROTECTION REQUIREMENTS:

A. Access to San Angelo State Supported Living Center is controlled. This Living center serves a unique and challenging clientele. Security requirements can be briefed at the pre-construction conference. Requirements are subject to change. Full cooperation by Contractor work forces is required. Contractor should anticipate certain notification and reporting requirements, preparation of forms and lists for pass and identification (badges) of employees and their vehicles, entry restrictions, key/lock control, and compliance with all Facility traffic rules and regulations.

1.7 FACILITY SPECIFIC WORKING CONDITIONS: Reference UGC/SGC Article 7 and see attached “Notice to Contractors/Visitors” for San Angelo SSLC.

A. **DEBRIS, CONSTUCTION, WASTE, ETC.** – Contractor must pick up all construction debris and waste materials daily. In addition to being unsightly, left behind or dropped items can be a serious health hazard to our residents. Some of our residents’ exhibit a behavior known as PICA. PICA refers to an individual who puts non-food materials into their mouths to eat. This could be a variety of items, such as; screws, pieces of metal, plastic bags, shards of glass and even candy/food wrappers.

E. **SYSTEM OUTAGES** – coordinate with the Maintenance Department, in advance, any utility or service outages you may need. The Maintenance Department will take care of notifying affected areas. The maintenance technicians can also be a big help to you in locating buried utilities, getting access to rooms and buildings.

F. **SIGN IN** – as a guest on the campus, each contractor’s crew is asked to sign in at the Plant Manager’s Office when arriving for work for the day. This will help the Maintenance Department answer questions from others on the campus who may inquire about “strangers” in or outside their buildings.

G. **SAFETY AT ALL TIMES** – contractors must perform their work safely and maintain especially high safety standards to avoid creating hazards to the

residents and staff of the campus. Contractors must anticipate that, due to the nature of the residents, there may be unusual behaviors and medical susceptibilities to be considered. Contractor personnel should discuss their work with the Maintenance Department to avoid unnecessary risk to people on campus and operations.

H. See attachment “Notice to Contractors/Visitors”.

END OF SECTION 01 50 00

# SECTION 01 70 00 – CLOSEOUT

PART 1 - AS-BUILT DRAWINGS AND REAL PROPERTY DOCUMENTATION:

1.1. AS BUILTS:

A. The Contractor shall maintain one set of the project drawings with red-lined "as-built" condition notations and markings. The Contractor shall mark these plans to indicate all "as-built" construction, changes, addenda, and utilities encountered and shall maintain them on the job site and available for viewing by the A/E, ODR, and/or the Facility at any time. These as-builts shall be readily available for review at each pay voucher meeting. Submit them to the A/E prior to substantial completion inspection for validation. Updated notations and markings shall be neat, clear, legible and accurate in all respects.

1.2. OPERATION & MAINTENANCE (O&M) AND INSTRUCTION MANUALS:

A. WARRANTIES/GUARANTEES: Refer to UGC/SGC Article 13.

1. Any warranties given to the Contractor or subcontractor at any tier from a manufacturer of equipment or other items, which are provided under this contract, shall be transferred to the Facility upon final acceptance in accordance with the clauses contained in the basic contract Uniform and Standard General Conditions. Contractor shall submit in writing a single listing with all applicable warranties, dates in effect, and all other pertinent information attached. This listing and the warranties shall be the first tab in the O&M Manuals described above.

1.3. CERTIFICATION OF NO ACM: Refer to UGC/SGC Article 13.7.

A. The Contractor must provide a <u>notarized</u> certificate attesting to the fact that no (ACM) Asbestos Containing Materials were incorporated into the work. This certificate shall be included as the second tab in the O&M Manuals described above.

1.4. FINAL PAY VOUCHER:

A. Refer to UGC/SGC Article 12. In particular be sure to provide Consent of Surety to Final Payment <u>and</u> Power of Attorney. Also, the affidavit of all bills paid is different from the monthly affidavit used for the previous pay vouchers.

END OF SECTION 01 70 00

# SECTION 03 01 30 - CONCRETE REHABILITATION

## PART 1 GENERAL

### 1.1. REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. ASTM INTERNATIONAL (ASTM)

1. ASTM C117 (2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
2. ASTM C136/C136M (2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C144 (2011) Standard Specification for Aggregate for Masonry Mortar
4. ASTM C31/C31M (2017) Standard Practice for Making and Curing Concrete Test Specimens in the Field
5. ASTM C33/C33M (2016) Standard Specification for Concrete Aggregates
6. ASTM C39/C39M (2017b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
7. ASTM C881/C881M (2015) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

### 1.2. DEFINITIONS

A. Epoxy Resin Binder

1. A two-component epoxy bonding system in low and medium viscosities used by itself as a primer or for producing epoxy concrete or mortars when mixed with aggregate.

B. Epoxy Concrete

1. A combination of epoxy resin binder and fine and coarse aggregate used in the repair of spalling along joints or cracks, small surface spalls or "popouts."

C. Epoxy Mortar

1. A combination of epoxy resin binder and fine aggregate used in the surface repair of non-structural cracks and filling of saw kerfs.

D. Non-Pressure Epoxy Grout

1. A combination of epoxy resin binder, a mineral filler and a thixotropic agent used in cementing dowels in place and the repair of non-structural cracks.

E. Pressure Grouting Epoxy

1. A low viscosity epoxy resin system pumped under pressure into structural cracks in walls or pavements.

1.3. SUBMITTALS

A. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00

1.4. SUBMITTAL PROCEDURES:

A. Design Data Job Mix Formula
1. SD-06 Test Reports Sieve Analysis Test for Aggregate Epoxy Resin Binder tests Epoxy Grout tests

1.5. Certificates

1. Epoxy Resin Binder
2. Epoxy Grout

1.6. Manufacturer's Instructions

1. Epoxy Repair Material

1.7. Submit for mixing and applying.

1.8. QUALITY ASSURANCE

A. Design Data

1. Job Mix Formula
2. Submit, at least 15 days before work commences, a job-mix formula for each use of [epoxy concrete] [epoxy mortar]. Test reports shall accompany the mix design. Identify the proposed source of the materials

and state the proportions of aggregates and epoxy resin. When determining job mix, use samples of materials to be used on the job.

B. Trial batches: Perform a minimum of three trial batchings in a

1. certified testing laboratory. Try different aggregate-resin
2. proportions to obtain satisfactory placing and finishing
3. characteristics but keep the proportion by weight of aggregate to epoxy
4. resin binder at least five to one. When mixing, add the fine
5. aggregates first, and then the coarse aggregates. The final trial
6. batch should be sufficiently wet so that some fines will "bleed" to the
7. surface during finishing operations.

C. Supporting criteria: Include in the submittal the following data for each trial batch:

1. Proportions by weight
2. Unit weights and specific gravities of constituents
3. Batch weights
   a) Compressive strengths of 76 by 152 mm 3 by 6 inch cylinders, made in accordance with ASTM C31/C31M, air cured for 7 days and tested in accordance with ASTM C39/C39M. Compressive strength shall be a minimum of 3000 psi.

4. Curing time

1.9. Test Reports

1. Epoxy Resin Binder Include the following:
   a) Viscosity
   b) Consistency
   c) Gel time
   d) Absorption
   e) Shrinkage
   f) Thermal compatibility

2. Epoxy Resin Grout Include the following:
   a) Epoxy number
   b) Consistency
   c) Compressive single shear strength
   d) Pot life

1.10. DELIVERY, STORAGE, AND HANDLING

A. Inspect materials delivered to site for damage, unload and store with a minimum of handling. Deliver epoxy resin components and aggregate materials

in original sealed containers and store in dry covered areas at temperatures below 30 degrees C 90 degrees F. Remove from job site unused mixed materials which have reached end of working or pot life.

1.11. WEATHER LIMITATIONS

A. Halt work when weather conditions detrimentally affect the quality of patching or bonding concrete. Apply epoxy resin materials only when the contact surfaces are completely dry and if the atmospheric and surface temperature ranges are suitable for the specified epoxy material. Follow manufacturer's instructions for weather conditions and temperature ranges.

1.12. TRAFFIC CONTROL

A. Do not permit vehicular or heavy equipment traffic on the pavement in the work area during the curing period. At the end of the curing period, light local traffic may be permitted on the pavement if approved by the Contracting Officer.

1.13. EQUIPMENT

A. Use a container recommended by the epoxy manufacturer as the mixing vessel. Use a power drive (air or spark-proof) propeller type blade for mixing except that hand mixing may be used for small batches. Use equipment specified by epoxy manufacturer for field mixing of aggregates and epoxy resin.

PART 2 PRODUCTS

2.1. MATERIALS

A. Epoxy

1. Epoxy Resin Binder for Concrete and Mortar ASTM C881/C881M, Type III, Grade [1] [2], Class [B] [C] without mineral filler. [For [walls] [and] [ceilings] use ASTM C881/C881M, Type III, Grade 3, Class [B] [C] with filler.]
2. 2.1.1.2 Non-Pressure Epoxy Grout ASTM C881/C881M Type IV, Grade [2] [3], Class [B] [C] with or without mineral filler.
3. 2.1.1.3 Crack Sealer for Pressure Grouting ASTM C881/C881M, Type IV, Grade 1, Class [B] [C] without filler.
4. 2.1.1.4 Crack Surface Sealer for Pressure Grouting ASTM C881/C881M, Type IV, Grade 3, Class [B] [C] with mineral filler.

B. Aggregate

1. For material passing No. 200 sieve provide a non-plastic material composed of a minimum of 75 percent limestone dust, talc or silica inert filler. Provide dry aggregate.

2.2. For epoxy concrete:

A. ASTM C33/C33M, [maximum size [_____][13 mm][1/2inch].] [Conform to the following requirements: Sieve Designation Percent Passing by Weight

1. 13 mm 1/2 in. 100
2. 10 mm 3/8 in. 93-100
3. No. 4 70-80
4. No. 8 50-65
5. No. 16 37-53
6. No. 30 20-37
7. No. 50 10-20
8. No. 100 5-10
9. No. 200 3-5]

B. For epoxy mortar:

1. ASTM C144, [maximum size [_____ mm][_____ inch].] [No. 8 sieve] [No. 40 sieve] [[_____] sieve].

PART 3 EXECUTION

3.1. PREPARATION

A. Epoxy Concrete

1. Patch Areas
   a) Remove loose concrete from the spalled areas indicated. Inspect the cavity for remaining defective concrete by tapping with a hammer or steel rod and listening for dull or hollow sounds. In areas where tapping does not produce a solid tone, remove additional concrete until testing produces a solid tone. Make the entire cavity at least 25 mm one inch deep. Sawcut edges of cavity to avoid feather edging. Prepare surface of cavity by sandblasting, grinding, or water blasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure cavity surfaces are dry.

2. Spalls at Joints and Cracks
   a) For spalls to be repaired that are adjacent to joints and working cracks insert preformed joint filler to the working faces of the spall. Trim filler to fit shape of the working faces of joint or crack so epoxy material is prevented from bypassing filler. Where practicable,

extend filler horizontally and vertically into joint or crack opening. Secure filler strip in place prior to and during placement of epoxy concrete. [Apply a bond breaker to working faces at keyed joints. Keep bond breaker off of concrete surface to be bonded.] After the epoxy concrete has completely cured, saw out the top 25 mm inch of the preformed joint filler and install liquid joint sealer.

3. Joints and Cracks
   a) Clean and seal joints and cracks as specified above.

4. Epoxy Mortar for Cracks and Saw Kerfs
   a) Apply epoxy mortar to newly exposed loose and unsound materials. Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy mortar.

5. Epoxy Grout for Cracks
   a) Apply grout to newly exposed concrete free of loose and unsound materials. Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy grout.

## 3.2. MIXING MATERIALS

A. Make batches small enough to ensure placement before binder sets. Mix materials in accordance with manufacturer's recommendations.

## 3.3. PLACEMENT

A. Epoxy Concrete

1. Prime dry cavity surfaces with epoxy resin using a stiff bristle brush. Make coating approximately 0.5 mm 20 mils thick. Place epoxy concrete while primer is still tacky and in layers not exceeding one inch thick. Use vibratory floats, plates, or hand tampers to consolidate the concrete. Level each layer and screed the final surface to match the adjoining surfaces. Remove excess epoxy concrete on adjacent surfaces before the concrete hardens. Do not feather epoxy concrete out onto adjacent surfaces.

B. Epoxy Mortar

1. Prime surfaces with epoxy resin binder. Scrub prime coat into surface with a stiff bristle brush. Make coating approximately 0.5 mm 20 mils thick. Place epoxy mortar while primer is still tacky. Apply at a thickness recommended by the manufacturer. Work mortar into place and

consolidate thoroughly so that contact surfaces are wetted by the mortar. Finish surface of mortar to the required texture. Do not feather edge epoxy mortar onto adjacent surfaces.

C. Non-Pressure Epoxy Grout

1. Cementing Dowels
   a) Immediately prior to placing the dowel, clean hole of dust and other deleterious material with a high pressure air hose. Fill hole halfway with grout. Insert dowel in hole by rotating it at least one complete turn while tapping it down. If necessary add more grout to fill hole.
2. Epoxy Grout for Cracks
   a) Apply epoxy grout at a thickness recommended by the manufacturer. Work grout into place and consolidate thoroughly so that contact surfaces are wetted by the grout. Finish surface of grout to the required texture. Do not feather edge epoxy grout onto adjacent surfaces.
3. Pressure Grouting of Cracks
   a) Clean each crack of dust, dirt, loose concrete and unsound material.
   b) Insert a valve at both ends of each crack, at the junction of two cracks, and along the length of each crack at 16 to 20 inch intervals. Fill crack between valves with crack surface sealer. After crack surface sealer has hardened and cured, pump crack sealer into valve at one end of crack. For vertical surfaces start at lowest valve and work upwards. As crack sealer appears at next valve, pinch closed pumping valve and move to next valve and commence pumping. Continue procedure until other end of crack is reached. Avoid delays in pumping operation. After crack sealer has hardened and cured grind valves off flush with concrete surface. Coat areas of valves with crack surface sealer and allow to harden and cure.

3.4. CURING

A. Cure epoxy materials in accordance with manufacturer's recommendations.

3.5. FIELD QUALITY CONTROL

A. Sampling

1. As soon as epoxy resin and aggregate materials are available for sampling, obtain by random selection a sample of each batch. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use and quantity involved.

B. Testing

1. At the discretion of the Engineer, samples provided may be tested by the Government for verification. Test samples by an approved laboratory. If a sample fails to meet specification requirements after two tests, replace the batch represented by the samples tested and retest. Test aggregates in accordance with ASTM C117 and ASTM C136/C136M.

C. Inspection

1. Check each repaired area for cracks, spalls, popouts and loss of bond between repaired area and surrounding concrete. Check each repaired area for voids by tapping with a hammer or steel rod and listening for dull or hollow sounds. Immediately repair defects.

END OF SECTION 03 01 30

# SECTION 03 30 00 – CONCRETE CAST IN PLACE

## PART 1 – GENERAL

### 1.1. REFERENCE STANDARDS

A. American Concrete Institute (ACI):

1. Recommended Practice of Evaluation of Compression Test Results of Field Concrete (ACI 214).
2. Specifications for Structural Concrete for Buildings (ACI 301).
3. Building Code Requirements for Reinforced Concrete (ACI 318).
4. Recommended Practice for Selecting Proportions for Concrete (ACI 613).
5. Selection and Use of Aggregate for Concrete (ACI Comm. 621)
6. ACI Manual of Concrete Inspection (SP-2).
7. Recommended Practice for Measuring, Mixing and placing concrete (ACI 614).

B. American Society for Testing Materials (ASTM):

1. Standard Method for Making and Curing Concrete Compression and Flexure Test Specimens in the Field (ASTM C 31).
2. Standard Specifications for Concrete Aggregates (ASTM C 33).
3. Standard Method of Test for Compressive Strength of Molded Concrete Cylinder(ASTM C 39).
4. Standard Method of Obtaining and Testing drilled Cores and Sawed Beams of Concreted (ASTM C 42).
5. Standard Specification for Ready-Mixed Concrete (ASTM C 94).
6. Standard Method of Test for Sieve of Screen Analysis of Fine and Coarse Aggregate (ASTM C 136).
7. Standard Method of Test for Slump of Portland Cement Concrete (ASTM C 143).
8. Standard Specification for Portland Cement (ASTM C 150).
9. Standard Method of Sampling Fresh Concrete (ASTM C 172).
10. Standard Specification for Air-Entraining Admixtures for Concrete (ASTM C 260).
11. Standard Specification for Chemical Admixtures for Concrete (ASTM C 494).

C. Portland Cement Association: Design and Control of Concrete Mixtures.

D. Latest Edition of each of above Governing Standards shall apply. Except as modified in this Section or the other related Sections, ACI 301 shall generally apply to all concrete work in this project.

### 1.2. SUBMITTALS

A. The proposed concrete mix design for each separate class of concrete shall be submitted by the Contractor for review by the Director of Engineering or his/her designated representative.

B. Design Mix Proportions together with certifications by an independent testing laboratory or by the material manufacturer that proposed grout setting bed for base and bearing plates will reach the specified strength shall be submitted for review by the Director of Engineering or his/her designated representative.

1.3. COORDINATION OF WORK

A. If concrete is supplied by a ready-mix concrete producer, the Contractor shall coordinate the delivery of all off-site produced concrete.

PART 2 – PRODUCTS

2.1. PORTLAND CEMENT

A. Portland cement shall conform to the requirements for Type I or III cement of ASTM C 150.

2.2. AGGREGATES

A. Fine aggregate shall consist of natural and/or manufactured sand having hard, strong and durable particles and which conform to the requirements of ASTM C 33.

B. Coarse aggregate shall consist of clean, hard fine-grained, sound crushed rock or washed gravel which do not contain in excess of five (5) percent by weight of flat, chip-like, thin, elongated, friable or laminated pieces, or more than on (1) percent by weight of shale or cherty material. Any piece having a major dimension in excess of two and one-half (2 ½) times the average thickness shall be considered to be flat or elongated. Coarse aggregate shall conform to the requirements of ASTM C 3

C. Refer to concrete quality table for maximum sizes of aggregate permitted for each class of concrete.

2.3. WATER

A. Water shall be clean water from the utility company mains, free from acids, alkalis, oils or organic materials and shall be suitable for dinking purposes.

2.4. ADMIXTURES

A. Air-entraining admixtures shall conform to ASTM C 260.

B. All other admixtures shall conform to ASTM C 494.

1. Type A: Water Reducing
2. Type B: Retarding
3. Type C: Accelerating
4. Type D: Water-Reducing and Retarding
5. Type E: Water Reducing and Accelerating
6. Type F: High-Range, Water-Reducing
7. Type G: High-Range, Water Reducing and Retarding

C. Approval of any admixtures is required before use in concrete.

D. No calcium chloride shall be used as an admixture under any circumstances in any concrete in this project.

2.5. EMBEDDED ITEMS

A. All embedded steel plates, shapes, etc. shall conform to the requirements of ASTM A 36 and shall be galvanized. Coat with “Galvanized” where galvanizing is damaged, at bends, and at welds etc.

B. Reinforcing steel bars:

1. Reinforcing steel bars for all concrete construction shall be deformed bars conforming to ASTM A 615, Grade 60, unless noted otherwise on the drawings.

2.6. QUALITY OF CONCRETE

A. The exact proportions of cement, aggregate and water for each class of concrete shall be determined by an approved independent testing laboratory. Mix design shall be based on the saturated surface dry (SSD) condition of the aggregate. The contractor shall pay for all mix designs.

B. Review by the Director of Engineering or his/her designated representative of mix design submitted does not relieve the contractor of the sole responsibility for each mix design to produce concrete of the strength specified.

C. The required minimum strength of concrete cores at 28 days, minimum laboratory strength in 28 days, minimum number of sacks of cement per cubic yard of concrete, maximum size of aggregated and required slump of the concrete as delivered at the job site for each of the indicated classes of concrete construction shall be as shown in the Concrete Quality table that follows:

CONCRETE QUALITY

| Class of Concrete Type Constr. | Minimum Core Test @28 Days (p.s.i) | Minimum Lab Test @28 Days (p.s.i) | Min.No. Sack of Cement Cu.Yd. | Maximum Aggregate Size (inches) | Req'd Slump (inches) | Admix-ture Type | Cement Type |
|---|---|---|---|---|---|---|---|
| Machine | 3000 | 3600 | 6 | ¾ | 3 ½ | E | I |

D. Slumps shown in the above Concrete Quality table are at place of final deposit of concrete Slumps tolerance shall be plus a minimum one (1) inch for 3 ½ inch or greater and plus a minimum ½" for 3" slump or less.

PART 3 – EXECUTION

3.1. STORAGE OF MATERIALS

A. Protect all materials from damage or contamination by water, dirt, or other substances while stored at either the project site or the production site and during delivery.

B. Store all materials above and clear of the ground surface except for aggregate.

C. The method of delivering the aggregates to the work and storing and handling shall be such that the moisture content of the aggregates as they come to the mixer shall not be subjected to frequent or unnecessary changes. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates.

3.2. MIXING OF CONCRETE

A. Measuring and mixing of concrete shall be in accordance with the recommended practices of ACI 614 and PCA.

B. All concrete shall be thoroughly mixed in approved batch-mixer conforming to the requirements of the Mixer Manufacturer Bureau of the Associated General Contractor of America.

C. All concrete materials shall be batched by weight. Materials for concrete shall be measured within the following percentages of accuracy:

| | | | |
|---|---|---|---|
| Cement | 1% | Water | 1% |
| Aggregates | 2% | Admixtures | 3% |

D. Fine and coarse aggregates shall be separately measured, and the water required by the concrete mix designs shall include the water that is contained in the aggregates. The method used for measuring shall be subject to the approval of the Director of Engineering or his/her designated representative and shall be such that all mix ingredients can be uniformly accurately controlled and easily checked. Fine and coarse aggregates shall be measured loose and moist as delivered on the job.

E. Each batch of 2 cubic yards or less shall be mixed for not less than 1 ½ minutes after all ingredients are in the mixer. Mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof. Each batch shall be completely discharged before another is mixed.

3.3. TRUCK-MIXED CONCRETE:

A. The use of truck-mixed concrete will be permitted if consistent with the general provisions of this Section and ASTM C 94.

B. The mixing time length and the number of revolutions of mixing shall conform to ASTM C 94. Concrete shall be rejected if not placed within 1 ½ hours after water is first added or if 300 revolutions have taken place, whichever comes first.

C. No water shall be added to any truck-mixed concrete after leaving the batching plant.

3.4. DELIVERY TICKETS

A. Duplicate delivery tickets, one for the Contractor and one for the Director of Engineering or his/her designated representative shall be furnished with each load of truck-mixed concrete delivered to the project site.

B. Delivery tickets shall provide the following information:

1. Ticket number
2. Date
3. Name of ready-mixed concrete producer
4. Name or number of plant at which concrete is batched
5. Truck number
6. Contractor's name
7. Job name and location
8. Type of cement used (i.e. I, III, air-entrained, etc.)
9. Class of concrete together with required strength, cement content, maximum size of aggregate and slump
10. Time dispatched from plant, time arrived at job site, time left job site

11. Type, name and amount of admixture, if any
12. Amount of concrete in load in cubic yards
13. Amount of water added at job, if any, with signature of person authorizing the added water

3.5. USE OF ADMIXTURES

A. Admixtures for the purposes of increasing workability or appearance of the concrete, or for improving any other characteristic, will be permitted, but only with the approval of the Director of Engineering or his/her designated representative. Any proposed admixture shall conform to the requirements of ASTM C260- or C 494.

B. Admixture shall be added by methods and in quantities recommended by the manufacturer. The Contractor shall be responsible for incorrect usage of type or quantity or admixtures.

3.6. CONCRETE TESTING PROCEDURES:

A. The Contractor shall furnish all materials that are to be tested at no cost to the Owner. All testing will be conducted in accordance with the herein before listed ASTM Standards and Specifications by an established independent testing laboratory selected and paid by the Owner.

B. The Contractor shall be responsible for notifying the laboratory at least 12 hours before it is necessary to make test cylinders. If the Contractor places concrete without notifying the laboratory, the Director of Engineering or his/her designated representative will have the concrete tested by means of a core test as specified in ASTM C 42 at the Contractor's expense.

C. Sampling of fresh concrete shall be in accordance with ASTM C 172.

D. Slump tests shall be made every time test cylinders are made in accordance with ASTM C 143 and reported by the testing laboratory. Additional slump tests may be required if any batches or deliveries are in doubt as to quality and as required for good control. The Contractor shall have slump measuring equipment available at the site at all times. Any slump test made by the Contractor shall be made in the presence of the Director of Engineering or his/her designated representative.

E. Test Cylinders will be made of concrete that is actually being placed at the project site and in accordance with ASTM C 31. Normally, one test shall consist of three cylinders: one for testing at end of 7 days and two (2) for testing at the end of 28 days. One test shall be made for each 50 cubic yards or fraction thereof in each day's placing and for each separate specified class of concrete.

F. The Contractor shall provide adequate facilities as required by the testing laboratory for safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours as required by ASTM C 31.

G. If the Contractor desires to remove shoring earlier than at 14 days, at least two additional cylinders for the purpose of determining the compressive strength of the concrete slab at the time of removal of the forms shall be made. Such test cylinders shall be properly identified, protected in the same manner that the corresponding concrete is being protected and left at the job site until required for testing. The Contractor shall pay for all of these additional tests.

H. Testing of cylinders will be in accordance with ASTM C 39.

3.7. EVALUATION OF CONCRETE TEST

A. The concrete cylinder tests shall be evaluated in the following manner.

B. The concrete shall be considered acceptable if:

1. The average of the two 28 days compression tests is equal to or greater than the required laboratory minimum 28 days strength specified for each particular class of concrete construction.
2. But, if any one of the two 28 day compression test is less than the average of these two tests by more than 10%, that entire test shall be considered erratic and no indicative of the concrete strength. Core samples will be required of this concrete.

C. Should any of the 28 day compression tests show an average compressive strength less than required laboratory minimum 28 day strength specified for each class of concrete construction, the cement content of the remaining concrete to be placed shall be increased as will be regulated by the Director of Engineering of his/her designated representative to insure concrete at adequate strength throughout the remainder of the work and no charge shall be made to the Owner for this increased cement content.

D. If any 28 day compression tests indicate that concrete of low strength has been placed which cannot safely, in the opinion of the Director of Engineering or his/her designated representative, sustain the loads for which it has been designed under laws and regulations, the concrete in question shall be tested by taking cores from such portions of the work as the Director of Engineering or his/her designated representative may direct. At least three representative cores shall be taken and tested as specified in ASTM C 42.

E. If compression tests of the core specimens show that the concrete is inadequate for design loads and stresses, the concrete shall be strengthened, defective members of materials replaced, or load tests of the area required as

will be regulated by the Director of Engineering or his/her designated representative.

F. The taking and testing of core samples, the replacement of strengthening of defective concrete and area load test shall be entirely at the expense of the Contractor.

3.8. TESTING OF CONCRETE

A. The Contractor will provide all materials that are to be tested. The Contractor shall notify the testing laboratory 24 hours prior to the placement of any concrete. The testing laboratory will submit three (3) copies of each report to the Director of Engineering or his/her designated representative and two (2) copies of the report to the Contractor. See General Requirements.

B. Concrete for each test shall be tested at the place of deposit for slump and entrained air and these values recorded on the test report.

C. The Contractor shall keep a standard slump cone and bull nosed rod on the job site for any additional slump tests required by the Director of Engineering or his/her designated representative where a variation of slumps is visible.

3.9. MEASUREMENT AND PAYMENT

A. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be considered subsidiary to pertinent items.

END OF SECTION 03 30 00

# SECTION 09 91 13 - EXTERIOR PAINTING

## PART1 - GENERAL

### 1.1 SUMMARY

A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.

### 1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each paint and coating product should include:

1 Product characteristics
2 Surface preparation instructions and recommendations
3 Primer requirements and finish specification
4 Storage and handling requirements and recommendations
5 Application methods
6 Clean-up Information

C. Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's color samples available.

D. Coating Maintenance Manual: upon conclusion of the project, the Contractor or paint manufacture/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturers name, label, and the following list of information:

1 Product name, and type (description)
2 Application & use instructions
3 Surface preparation
4 VOC content
5 Environmental handling
6 Batch date
7 Color number

B Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

C Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.5 PROJECT CONDITIONS

1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not apply coatings under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
The Sherwin-Williams Company
Benjamin Moore
PPG
Kwal Paints
Dunn Edwards
Pre-approved equal

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[ and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
Primers, Sealers, and Undercoaters: 50 g/L.

2.2 APPLICATIONS/SCOPE

A. "Paint Everything" listed in the finish schedule including but not limited to:

B. Surfaces to Be Coated:

Concrete: Cementitious Siding, Flexboard, Transite, and Shingles (Non-Roof)
Masonry: Concrete Masonry Units, Cinder or Concrete Block

Exterior Paint Schedule - Commercial

Exterior Chimney Block Areas (Porous):

Chimney Finish
Filler: Loxon Block Surfacer, A24W200, <100 g/L VOC
1st coat: Exterior Loxon XP, <50 g/L VOC
2nd coat: Exterior Loxon XP, <50 g/L VOC

2.4 MATERIALS - GENERAL REQUIREMENTS

A Paints and Coatings - General:
1 Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such a procedure is specifically described in manufacturer's product instructions. VOCs need to be confirmed by using the products MSDS sheets.

B Primers:
1 Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

2.5 ACCESSORIES:

A Coating Application Accessories:
1 Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required per manufacturer’s specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A Do not begin application of coatings until substrates have been properly examined and prepared. Notify Engineer of unsatisfactory conditions before proceeding

B If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

C Proceed with work only after conditions have been corrected, and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

D Previously Painted Surfaces: Verify that existing painted surfaces do not contain lead based paints, notify Engineer immediately if lead based paints are encountered.

3.2 SURFACE PREPARATION:
WARNING! Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain

damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority. Removal must be done in accordance with EPA Renovation, Repair and Painting Rule and all related state and local regulations. Care should be taken to follow all state and local regulations which may be more strict than those set under the federal RRP Rule.

A. Proper product selection, surface preparation, and application affect coating performance. Coating integrity and service life will be reduced because of improperly prepared surfaces. Selection and implementation of proper surface preparation ensures coating adhesion to the substrate and prolongs the service life of the coating system.

B. Selection of the proper method of surface preparation depends on the substrate, the environment, and the expected service life of the coating system. Economics, surface contamination, and the effect on the substrate will also influence the selection of surface preparation methods.

C. The surface must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

D. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

E. No exterior painting should be done immediately after a rain, during foggy weather, when rain is predicted, or when the temperature is below 50°F, unless products are designed specifically for these conditions. On large expanses of metal siding, the air, surface and material temperatures must be 50°F or higher to use low temperature products.

## 3.3 INSTALLATION

A Apply all coatings and materials with the manufacturer's specifications in mind. Mix and thin coatings according to manufacturer's recommendation.

B Do not apply to wet or damp surfaces.

1 Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days.
2 Test new concrete for moisture content.

3 Wait until wood is fully dry after rain or morning fog or dew.

C Apply coatings using methods recommended by manufacturer.

D Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

E Apply coatings at spreading rate required to achieve the manufacturer's recommended dry film thickness.

F Regardless of number of coats specified, apply as many coats as necessary for complete hide.

H Inspection: The coated surface must be inspected and approved by the Engineer just prior to the application of each coat.

3.4 PROTECTION

A Protect finished coatings from damage until completion of project.

B Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION 09 90 00

# SECTION 22 05 00 – GENERAL MECHANICAL REQUIREMENTS

## PART 1 – GENERAL

### 1.1. RELATED DOCUMENTS

A. Drawings, General Conditions of the Contract for Construction, Supplementary Conditions and Division 1 – General Requirements apply to work of this section.

### 1.2. DESCRIPTION

A. Work covered by this Division shall consist of furnishing all labor, equipment, supplies and materials and in performing all operations necessary for the installation of complete and operating mechanical systems as required by these specifications and/or shown on the drawings, subject to the terms and conditions of the contract. The work shall also include the completion of such mechanical and electrical details not mentioned or shown which are necessary for the successful operation of all systems described on the drawings or required by these specifications; this includes the furnishing all materials for the filling the systems to make them operable, including water, refrigerant, oil and grease. Prove satisfactory operation of all equipment and controls to the Engineer on request.

B. Work not included – Certain labor, material and equipment may be furnished and/or installed under other divisions of these specifications. This Contractor shall coordinate with other trades and arrange his work to make the parts fit together. The following items are to be accomplished under other divisions of these specifications:

1. Temporary Heat: Refer to paragraph in this Section.
2. Temporary Water and Toilet: Refer to General Conditions.
3. Electrical Equipment and Wiring: Refer to paragraph in this Section.
4. Concrete: Refer to paragraph in this Section.

C. Equipment Furnished by Owner – Rough-in services pipes to locations as required by electrical and mechanical drawings and equipment shop drawings. Provide service valves on all pipes except waste and vent pipes. Plug and cap all waste and vent pipes. Final Connection to equipment will be made by this Contractor.

D. Where new work is applicable to patient/client living, use, or support areas; contractor shall obtain an approved infection control permit prior to initiating actual work. Permit application shall be initiated with his mobilization submittal. (see UGCS/SGCS article 7.8.).

## 1.3. BIDDING

A. All mechanical equipment shall be new unless specified otherwise in the specifications or on the drawings. All work is new unless otherwise indicated to be "existing" or "reused" or "relocated".

B. All bids must be based only on the equipment and materials as scheduled on the drawings and as specified or on equivalent equipment and materials from a preapproved alternative manufacturer. No bid may be based on a substituted or other alternative without specific written prior approval from the Engineer. Any Contractor who assumes equivalence of products and who bases his bid on that assumption does so at his own risk.

C. A listing of approved alternative manufacturers does not mean that all products of an alternative manufacturer are acceptable alternatives to the scheduled items; it merely means that for bidding prior approval is not required. All fixtures and devices must still be submitted according to the prescribed procedures. In addition, some items that have an important visual affect, e.g. electric water coolers, may be required to receive Owner's or Engineer approval also.

D. Prospective bidders are highly encouraged to attend the scheduled pre-bid site visit to thoroughly familiarize themselves with any and all existing site and project location conditions which may affect the work under this contract. The Owner and Engineer will not be responsible for Contractor errors or omissions which could be made reasonably known by attending a scheduled site visit.

E. Wherever the word(s) "provide", "furnish", "install" and/or the like is/are used; it is to be defined as and understood to require that the contractor shall provide the item/system(s) totally and completely furnished, installed, and fully operable and useable for its/their intended purpose(s) unless specifically noted otherwise in the contract documents.

## 1.4. EXISTING UTILITIES

A. The drawings indicate the locations, type and sizes of various utilities within the site where known. These utilities are indicated as accurately as possible. If the Contractor encounters any utilities or differing conditions during construction, which are not shown on the drawings, they shall request in writing for written instructions from the Engineer. Any relocation or remodeling required will then be directed by a change order. This Contractor shall assume all responsibility for protection of all utilities, shown or not, and for repair required by this construction. Existing underground utility locations shown are approximate. Contractor shall field verify. Exact locations prior to excavation or trenching. Contractor shall hand dig within 5

feet either side of potential utility conflicts/interferences until the utility is physically exposed prior to performing mechanical trenching or excavating.

B. Contractor shall verify location, size, elevation, pressure and any other pertinent data of the existing utilities. The Contractor shall provide a written report with drawings indicating the existing utilities information, such as utility locations and sewer invert information. Additional costs incurred due to failure to verify such data and to coordinate associated work with respective utility providers shall not be the Owner's responsibility but shall be borne by the Contractor.

C. All costs associated with providing utilities including, but not limited to, connection fees, meters, boring under roads, etc., shall be included in the Contractor's bid price whether such costs are incurred by Contractor or charged by the utility company.

D. Submission of a bid by the Contractor shall be considered an acknowledgment by the contractor of his compliance with this section.

E. The Contractor shall coordinate with Owner and this Engineer's office any work that has the potential to hinder mechanical and plumbing services to areas outside this contract. All shut downs or tie-ins relating to these systems shall be scheduled and submitted in writing to be approved by the Owner and this Engineer's office. Contractor shall submit in writing a schedule of construction phasing that indicates areas of priority during each phase and anticipated completion times. Schedules shall be submitted a minimum of 7 days prior to commencing work. Owner and this Engineer's office shall review these schedules and notify the contractor of acceptance prior to commencement of work.

## 1.5. CODES, PERMITS AND FEES

A. Contractor shall comply with all local, state and national codes and shall pay for all applicable costs, meter costs, fees, permits, licenses and inspections for this division

B. The mechanical work shall be performed in strict accordance with the applicable and Adopted provisions of the International Building Code International Plumbing Code, International Mechanical Code and International Energy Conservations Code as adopted and interpreted by the State of Texas, Texas Health and Human Services Commission and the National Fire Protection Association (NFPA) regulations, current adopted edition regarding mechanical systems, fire systems and electrical systems. All materials and labor necessary to comply with Rules, regulations and ordinances shall be provided. Where the drawings and/or Specifications indicate materials or construction in excess of code requirements, the

Drawings and/or specifications shall govern. The contractor shall hold and save the Owner and Engineers free and harmless from liability of any nature or kind arising from his failure to comply with all applicable codes and ordinances.

1.6. TEMPORARY HEAT

A. Temporary heat will be furnished by the Contractor. Use of the permanent heating system will not be allowed without written authorization from the Engineer and Owner. In case the permanent heating system is used for temporary heat, the Contractor shall pay all the costs until acceptance by the Owner. Warranty of equipment shall not start until acceptance by the Owner.

1.7. DRAWINGS

A. Contract drawings are diagrammatic only and are not intended to be scaled for dimensions. All dimensions shall be taken from certified equipment drawings and from the structure itself before fabricating and work. All space requirements shall be verified, coordinated with other trades, as it is the various Contractors' responsibility to install the systems complete in the space provided without extra charges to the Owner.

B. It is intended that anything, including labor and materials, which is usually furnished as part of any equipment specified and which is necessary for operation shall be furnished as part of the Contract without additional cost, whether or not shown or described.

C. All piping in finished areas of the building shall be concealed except where otherwise noted on the drawings.

D. All equipment shall be installed in accordance with manufacturer's recommendations, unless approval is given in writing be the Consulting Mechanical Engineer for deviation prior to commencement of work.

E. The plans indicate the extent and general requirements of the demolition, alterations, relocations, and additions. If any departures from the drawings are deemed necessary by the contractor, details of such departures and the reasons therefore shall be submitted as soon as possible to the Engineer and Owner for action. No such departures shall be made without prior approval of the Engineer and Owner.

F. Every effort has been made to clearly and fully depict all known existing conditions and items requiring removal, relocation, demolition and/or alteration. Due to the small scale of the drawings and the nature of renovation and rehab work certain items such as those concealed behind

equipment, finishes, or structural members and the like; or those not accessible for inspection or identifiable as abandoned or to be abandoned without destruction; may not be specifically and/or separately defined or shown. The Contractor shall provide all required removal, relocation, demolition, and/or alteration of such items reasonably inherent with such renovation and rehabilitation work at no additional cost to the Owner in accordance with the best commercial practices and these contract documents to provide a complete and useable facility within the scope of the work to be performed. No consideration shall be given to the nature of the materials, and all demolition shall be designated as unclassified demolition. Demolition of every description and of whatever substances encountered shall be performed to the degree required for the installation of the items/finishes required herein or as specified.

1.8. REQUIREMENTS OF REGULATORY AGENCIES

A. The mechanical work shall be performed in strict accordance with the local and state codes, ordinances, and regulations governing the particular work involved. Furnish, without extra charge, any additional material and labor when and where required to comply with these Rules and Regulations, though the work is not mentioned in the Specifications or shown on the Drawings. When the Specifications or Drawings call for or describe materials or construction of a better quality or larger sizes than required by the above-mentioned Rules and Regulations, the provisions of these Specifications and accompanying Drawings shall take precedence.

1.9. QUALIFICATIONS

A. All mechanics shall be capable journeymen, apprentices or helpers, skilled in the work assigned to them with licensing required by the inspecting authority. All welders must have been certified within the past three years to perform the work, which they are doing.

1.10. WARRANTY

A. All materials and equipment shall be new unless otherwise specified.

B. Guarantee all workmanship, material and equipment and replace any found defective without cost to the Owner, for ONE year after final acceptance, as defined in General Conditions.

C. Each warranty for longer than one year as described above (that comes with equipment used on the job) shall be passed into the Owner in the Operation and Maintenance Manual, along with the dates of start and end of warranty.

D. Refer to General Conditions for additional information regarding specific warranty requirements.

1.11. PROJECT RECORD DOCUMENTS

A. Before final payment, provide the Engineer with one clean set of drawings and specifications corrected up-to-date as job progress. These documents shall reflect the As-Built conditions. Refer to General Conditions for additional information.

1.12. SUBMITTALS

A. The intent of this section is to give general submittal information, refer to specific submittal information in the subsequent mechanical sections.

B. Within 10 days after award of the contract, and before orders are placed, Contractor shall submit specific information on list of equipment and principal materials specified. Contractor shall indicate and/or provide names of manufacturers, catalog and model numbers, cut sheets, and such other supplementary information as necessary for evaluation. Minimum of six (6) copies, or as directed by the Engineer, of each shall be submitted and shall include all items mentioned by model number and/or manufacturer's name in the specifications or in schedules on the drawings.

C. Requirements for each submittal:

1. Bear a dated stamp or specific written indication that the primary Contractor have reviewed and approved all submittal prior to submission to Engineer,
2. Have all information deleted by Contractor that pertains to the means and methods of construction or to fabrication, assembly, installation, or erection (approval by Engineer shall not extend to these areas unless specifically noted by Engineer),
3. **BE CLEARLY AND SPECIFICALLY MARKED AS TO WHICH SPECIFIC PIECE** of equipment is being submitted, bye use of a permanent marker, stamp, etc., so as to distinguish it from other pieces of equipment that may occur on the same page,
4. **BE CLEARLY AND SPECIFICALLY MARKED AS TO WHICH AVAILABLE OPTIONS ARE BEING SUBMITTED** that are associated with a piece of equipment, and be complete with respect to quantities, dimensions, specific performance, materials, and similar data to enable the engineer to review the proposed equipment. Be complete with respect to quantities, dimensions, specific performance, materials, and similar data to enable the Engineer to review the proposed equipment.

5. **BE CLEARLY AND SPECIFICALLY MARKED AS TO ANY AND ALL SUBMITTAL DEVIATIONS** from the design specification requirements shall be provided in written form.
6. Omission by Contractor of any of the above requirements or submittals will subject submittal to automatic rejection without review.
7. Any submittals received by Engineer that were not requested shall be returned without review of any kind.
8. Submittals shall indicate minimum access and service clearances if required by the submitted equipment.

D. Installation Instructions – For certain products or systems as identified in subsequent specifications sections or on the drawings, the Contractor shall be required to provide copies of manufacturer's installation instructions with the submittal. When required as such, the installation instructions are considered part of the submittal and their omission may result in automatic rejection of the submittal. Where more than one identical device are scheduled, only one set of installation instructions needs to be submitted, e.g. if seven five-ton split systems air conditions are scheduled, only one five-ton unit installation instruction needs to be submitted. Similarly, if one set of installation instructions is identified by the manufacturer and on the instructions to be applicable to more than one type or size of devices, e.g. if one set of air conditioner instructions is good for three, four, five-ton units, then only one instruction set is required for these devices.

E. This Engineer will review the submittals for approval twice. Any additional reviews that are required by the engineer for whatever reason after the initial two reviews will result in additional compensation for the Engineer's time by the submitting Contractor at the Engineer's rate.

1.13. PRIOR APPROVAL OF SUBSTITUTED PRODUCTS

A. Material or equipment specified by Manufacturer's name and model number is being used as a basis of standard and performance. No substitution is allowable without Engineer's written approval **FOURTEEN (14) DAYS PRIOR TO BID DUE DATE** unless the manufacturer is listed on the drawings and/or in the specification as being a preapproved alternative manufacturer.

B. A prior approval submittal package shall at a minimum consist of the following items:

1. One copy of the product submittal in accordance with the paragraph in this section titled SUBMITTALS.
2. Plan layouts sketches of mechanical rooms or systems of the substituted equipment showing that the proposed equipment will fit within the space allocated with the manufacturers and code required

clearances for the substituted equipment as well as the other equipment in the space.

3. Indications of any structural modifications required for the proposed substitution, such as additional weight or opening size changes.
4. Indications of any electrical modifications required for the proposed substitution, such as changes in breaker sizes, wiring requirements.
5. Indication of any deviations from the specified equipment or their performance.

C. It shall be the Manufacturer and/or their authorized Representative's responsibility to verify that submitted substitute equipment will fit in space available. The Manufacturer and/or their authorized Representative's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but complete.

D. The Manufacturer and/or their authorized Representative's shall be responsible for the costs of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete, that is, it shall include the cost effect of any and all other trades.

1.14. SUBSTITUTED PRODUCTS

A. Material or equipment specified by Manufacturer's name is being used as a basis of standard. No substitution is allowable without Engineer's written approval **FOURTEEN (14)** days prior to bid due date unless the manufacturer is listed on the drawings and/or in the specification as being a preapproved alternative manufacturer. Any submittal received without such written approval or prior approval is subject to unqualified rejection.

B. It shall be the Contractor's responsibility to verify that submitted substitute equipment will fit in space available. The contractor's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but complete.

C. The Contractor shall be responsible for the costs of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete, that is, it shall include the cost effect of any and all other trades.

D. The Engineer may request detailed shop drawing or plan layouts of mechanical rooms or systems of the substituted equipment.

E. Should a substitution be approved by the Engineer (based upon the substitution submittal) and accepted, and should the substitute material or equipment prove defective, not meeting design parameters, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.15. SAFETY

A. General – Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work, and Contractor shall comply with all laws governing safety, specifically the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", state and federal.

B. According to OSHA, a hazardous chemical is any chemical, which is a physical hazard or a health hazard. This may include items such as paints, solvents, adhesives, sealants, cleaners, etc. If a contractor produces, uses, or stores hazardous chemicals at the workplace, the contractor shall develop, implement, and maintain a hazard communication program in compliance with the latest OSHA requirements. In projects with multiple tenants in which the building is partially occupied during all or part of the project, Contractor shall inform the building manager or Owner, according to OSHA guidelines, of any hazardous chemicals being produced, stored, or used in the building so that other tenants may be notified. Contractor shall employ required methods of training, information, handling, ventilation, labeling, storing, disposal, and removal of hazardous chemicals.

1.16. LABELING

A. Each device for which an independent testing authority has established a standard shall have affixed a label indicating its compliance and listing. Refer to General Conditions for list of such independent testing authorities.

1.17. SITE VISIT REPORTS

A. During the course of the job, the Engineer will make site and inspection visits to observe work in progress and will subsequently prepare a written site visit report, which will be sent to the Contractor and to whomever else the engineer desires. The Contractor shall provide 48 hour written notice to the engineer for all testing and city inspection, so they can attend these inspections. The Contractor shall prepare a written and typed response within seven (7) calendar days of his receiving the site visit report and record them in the weekly progress reports. The Contractors shall accompany the engineer during these site visit upon the request of the

Engineer. The Contractor shall include in his response the following information.

1. Date of site visit by the Engineer,
2. Date of receipt of the site visit report,
3. Name and title of the preparer of the response,
4. An item number referenced to the site report,
5. A brief three or four-word description of the item,
6. The Contractor or Subcontractor affected,
7. The proposed course of action, and
8. An expected time of completion of the action.

1.18. FINAL PUNCH REPORTS

A. At the completion of the job, the Engineer will make punch list site visits to observe completed work and will subsequently prepare a written site visit punch list report, which will be sent to the Contractor and to whomever else the Engineer desires. The Contractor upon completion of the listed punch list items shall prepare a type written response to the list indicating completion of each item. The Contractor shall include in his response the resolution of each item. The Contractors shall accompany the Engineer during this final punch list visit upon the request of the Engineer.

1.19. CUTTING AND PATCHING

A. No joists, beams, girders, columns, slabs, or other structural elements shall be cut, drilled, or altered in any way by the Contractor without first obtaining written permission and instructions from the Engineer.

B. Where it is necessary to cut through any non-structural elements of walls, floors, or ceilings to permit the installation of any work under this contract, or to repair any defects that may appear up to expiration of the guarantee, such cutting shall be done by the Contractor with as little damage as reasonably possible to the element being cut or to adjacent elements.

C. After the necessary work has been completed, the damage shall be repaired by the respective Contractor, who shall pay all costs of such cutting, repairs and patching. All patching or sealing of cuts and penetrations, including final appearance of same, shall be done to the approval of the Engineer.

D. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

1.20. INSURANCE

A. The Contractor shall have required insurance. Required insurance shall be provided by this Contractor for protection against public liability and property damage for the duration of work.

1.21. CONFLICTS AND CORRECTION OF WORK

A. Promptly correct work rejected or failing to conform to the requirements of the Contract, whether observed before or after substantial completion and whether or not fabricated, installed or completed. The Contractor shall bear cost of correcting such rejected and nonconforming work including additional testing and inspections and including compensation for observing mechanical and electrical engineering firm's services and expenses made necessary thereby.

B. If a conflict occurs on the bid documents, the Contractor shall contact the Engineer's office with a written request for clarification. If the conflict is un-resolvable at the time of bid, the most expensive interpretation of the conflict shall be bid so the conflict can be resolved in a deductive manner at a later time if necessary.

C. If a conflict is discovered during construction, the Contractor shall stop work and that portion of the project and contact the appropriate party for clarification. The request for clarification shall be in written form. The Contractor shall bear the burden of replacing work that has been installed incorrectly as a result of a conflict on the drawings where he has not sought the Engineer's guidance for clarification.

D. If during construction a conflict is discovered between the drawings, the specifications, and/or the manufacturer's installation requirements the most stringent shall apply unless written clarification is obtained from the Engineer.

1.22. COORDINATION

A. In a timely manner, coordinated with all work involved for the following areas:

1. Where new work of three or more trades or subcontractors is installed.
2. Where new work is installed in existing areas.
3. Where lead times are critical to the project schedule.
4. Provide construction grade drawing as needed to acquire approval of work plan.
5. Access or service spaces required for HVAC and plumbing equipment.

B. Any occasion that requires the Engineer to be in attendance, the Contractor shall give the Engineer 24-hour notification.

PART 2 – PRODUCTS

2.1. MATERIALS

A. All materials shall be new and of specified quality, unless specifically noted otherwise. Materials shall be free from defects. Where manufacturer names are mentioned in the specifications or on the drawings, it has been done to establish a standard of quality and construction.

B. Contractor will be responsible for transportation of his material to and from the job site and will be responsible for the storage and protection of his materials and work until the final acceptance of the job. At the end of each day of work, each Contractor is responsible for covering or protecting his work and/or materials that may be susceptible to damage even if such damage is the result of unforeseen causes, e.g. an overnight thunderstorm. Failure to do so will be sufficient cause for rejection of any item in question, and any such item shall be replaced by Contractor at no cost to the Owner.

C. Contractor shall verify that all pieces of equipment will fit through available openings in the building and that all equipment can be installed without modification of building structure.

2.2. EQUIPMENT SCHEDULE

A. All equipment major items are specified in the equipment schedules on the drawings and shall be new and furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.

B. Equipment items so noted will require start-up by factory-trained personnel. Equipment items so noted will require factory approved service personnel who shall provide all service, including all parts and all labor, as requested by the Owner, during the full period of equipment warranty.

2.3. EQUIPMENT RATINGS

A. Equipment capacities as scheduled on the drawings are at project site altitude. Capacities of submitted equipment must be corrected for project site altitude unless otherwise noted.

2.4. WORKMANSHIP

A. The workmanship shall, in all respects, be of the highest grade, and all construction shall be done according to the best practices of the trade. Piping, ducting and conduit shall be concealed unless otherwise noted, and installed square to the building lines. Any work not meeting this requirement shall be replaced or rebuilt without extra expense to the Owner.

2.5. ELECTRICAL EQUIPMENT AND WIRING FOR AND MECHANICAL DIVISION

A. Responsibility

1. Unless otherwise indicated, all motors, conduit, wiring, and controls (including temperature) shall be furnished, set in place, and wired in accordance with the following schedule. (MD is Mechanical Division and ED is Electrical Division)

| **MECHANICAL-ELECTRICAL COORDINATION TABLE 1** | | | |
|---|---|---|---|
| ITEM | FURNISHED UNDER | SET IN PLACE OR MOUNTED UNDER | WIRED AND CONNECTED UNDER |
| 1. Equipment Motors and Thermal Overloads | MD | MD | ED |
| 2. Motor Controllers(HOA): magnetic starters, and overload relays | MD (1) | ED (1) | ED |
| 3. Disconnect switches, fused or unfused, variable frequency drive (VFD) controllers (HOA), thermal overload switches and fuses, | ED (1) | ED (1) | ED |
| 4. Pushbutton stations(HOA), float switches, thermostats, control relays, motor valves, and interlocks | MD | MD (2) | MD (2) |
| 5. Contactors, 120V control circuit outlets for control panels and for boiler controls | ED | ED | ED |

Notes:

1. If furnished as part of factory wired equipment, wiring, conduit, and connection only by ED
2. If float switches, etc., carry the FULL LOAD CURRENT of any motor, they shall be furnished by the Mechanical Division, but shall be set in place, wired and connected by the Electrical Division, except that where such items are an integral part of the mechanical equipment, they shall be set in place under the Mechanical Division and wired and connected by the Electrical Division. If they do not carry the FULL LOAD CURRENT to any motor they shall be furnished, set in place and wired under the Mechanical Division.
3. Wiring and conduit from alarm contacts to alarm system and conduit for control functions by ED; set in place and all control function wiring by MD.
4. Mechanical division to set in place, Mechanical Contractor to make mechanical connections and Electrical Contractor to make electrical connections.

B. Connections

1. Connection to all control directly attached to ducts, piping and mechanical equipment shall be made with flexible connections not to exceed 3 linear feet.

2.2. ELECTRICAL WIRING AND CONTROL EQUIPMENT

A. All disconnects, motor starters, relays, wiring, conduits, etc. shall be provided by and comply with all requirements of 26 05 00 Sections of the electrical specifications.

B. The Mechanical Contractor must refer to the electrical control equipment and wiring shown on the Electrical Drawings. Any changes or additions required by specified equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.

C. All electrical equipment characteristics (voltage, phase, etc.) must be verified by the Contractor prior to ordering. It is imperative that voltage and phase characteristics are checked with the electrical drawings.

D. All motors shall be built in accordance with the current applicable IEEE, ASA and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion-proof when located in hazardous atmospheres. Type II weather-protected motors may be used in lieu of TEFC motors on roof fan units and similar equipment. Motors mounted in direct sun shall be provided with a shield to forbid direct radiation from the sun when the sun is 45 degrees or greater above the horizon.

E. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40ºC rise and total temperature rise of 65ºC ambient and when powered from the system voltage feeding the motor. TEFC motors shall have a service factor of 1.00 with total temperature rise of 65ºC in the above conditions. Single-phase motors shall be NEMA Type N split phase induction motors with built-in thermal protectors. Single-phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors.

F. All motors shall be all copper wound, high power factor, high efficiency motors. Electric motors shall be an energy efficient type as defined in the latest edition of NEMA document no. MG1. Motor efficiency shall be made available to the Engineer as required.

## 2.3. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

## 2.4. EQUIPMENT AND PIPING SUPPORTS

A. All supporting systems for piping, equipment, and materials supported by the building structure shall be submitted to the Engineer for approval prior to purchase and installation.

## 2.5. ACCESSIBILITY

A. Access Panels

1. Access panels shall be provided wherever necessary for possible future replacement, adjustment, or maintenance of operating devices such as machinery, valves, dampers, switches, relays, plumbing fixtures such as trap primers and air gap fittings, or to other critical non-operating devices such as pull boxes, inspection parts, and gauges. Such access panels shall be provided and install by Contractor, whether or not shown on the drawings, and shall be brought to the attention of the Engineer for approval of type, color, fire

rating. Where access is provided in rated members, the access panels shall be of a type that maintains the integrity of the member penetrated

B. Access to Equipment

1. All pipes, tubing, conduit, etc. including, but not limited to, draining piping of any type, electrical conduit, wiring not in conduit, and pneumatic control tubing shall be installed in such a way so as not to prevent and/or not to make necessary difficult the removal, operation, use, or maintenance of equipment, access panels or doors, pathways (especially in attics or crawlspaces), observation ports, measurement or balancing devices, junction boxes.
2. If access for these purposes is prevented or made unreasonably difficult in the opinion of the Engineer, then the Contractor shall make modifications or repairs at no cost to anyone except the Contractor. Such modifications or repairs shall be considered neither complete nor adequate until the Engineer is satisfied that access for the above purpose is achieved.

PART 3 – EXECUTION

3.1. STORAGE

A. Provide for proper storage of all materials and equipment and assume responsibility for losses due to any cause. All storage shall be within the contract limits of the building site or in a bonded warehouse. All equipment and materials must be covered and stored out of the elements; any item, which has become rusted, will not be permitted to be used.

B. Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be rainproof and lockable as required. Materials or equipment stored on site but not in a lockable rainproof storage facility shall be stored above ground or above slab. Contractor shall take necessary precautions to prevent entry of and/or damage from dirt, trash, water, or vermin. Equipment not properly stored and protected shall be, at the discretion of the Engineer, replaces at no cost to the Owner. Roofs are not acceptable storage areas unless specifically allowed in writing by the Engineer.

3.2. INSTALLATION AND ARRANGEMENT

A. Install all work to permit removal (without damage to other parts) of coils, heat exchanger bundles, boiler tubes, fan shafts and wheels, filters, belt guards, sheaves and drives, plumbing fittings, and all other parts which might require periodic replacement or maintenance. Arrange pipes, ducts

and equipment to permit ready access to valves, traps, starters, motors, control components and to clear opens of doors and of access panels.

B. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping pipes whether or not indicated on the drawings. Furnish and install all traps, air vents, sanitary vents, as required to affect these offsets, transitions and changes in direction.

C. Mechanical Contractor shall coordinate with other trade with regards to equipment going under mechanical equipment.

D. Mechanical Contractor shall install HVAC and plumbing equipment in a manner to provide the manufacturer's recommended service clearance and access space. The Mechanical Contractor shall be responsible for maintaining these clearances, coordinating them with the other trades and have installed work modified to maintain these clearances at no additional charge to the project or the Owner.

3.3. PROTECTION OF WORK AND PROPERTY

A. Where there are existing facilities, be responsible for protection thereof, whether or not such facility is to be removed or relocated or remain as installed. Moving or removing any facility must be done so as not to cause interruption the work or Owner's Operation.

B. All pipe and duct openings shall be closed with caps or plugs during installation. All fixtures shall be covered and protected against injury. At final completion, all work shall be cleaned and delivered in an unblemished condition or refinished and repainted at the desecration of the Engineer.

3.4. CONCEALED AND EXPOSED WORK

A. "Concealed" is intended to mean within such spaces as pipe chases, pipe trenches, above plaster ceilings, in walls and buried pipe is inaccessible when building is completed. "Exposed" is intended to be within equipment rooms, unfinished spaces, above "pushup" ceilings, accessible pipe tunnels, where pipe is accessible.

3.5. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify and coordinate locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

3.6. CONCRETE

A. This Contractor shall coordinate all requirements for concrete. All concrete shall be furnished under the Division 3 of these specifications.

B. For outdoor equipment on grade and indoor floor mounted mechanical equipment, the Contractor shall construct level 3000 psi concrete slabs with finished edges, wire reinforced, minimum 3 1/2" thick, and minimum 6" larger on all sides than the equipment being supported or as indicated on the drawings.

3.7. TRENCHING AND BACKFILLING

A. All excavation, trenching and backfilling required for the mechanical installation shall be provided by this Contractor. Excavation and backfilling shall be done in strict accordance with the specification section for trenching, excavation, and backfilling, see Division 2.

3.8. FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions and conditions governing work at the project site. He shall examine adjoining work on which his work is dependent, for perfect efficiency, and shall report any work, which must be corrected.

3.9. LUBRICATION

A. The Contractor shall provide all oil and grease for the operating of all equipment until acceptance. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. The Contractor shall protect all bearings and shafts during installation and shall thoroughly grease the steel shafts to prevent corrosion.

3.10. MANUFACTURER'S DIRECTION

A. The Contractor shall install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, the

Contractor shall report such conflicts to the Engineer who shall make changes deemed necessary and desirable.

3.11. FLUSHING, CLEANING & STERILIZING

A. Clean ductwork under provisions of 01 70 00 and 23 31 00.

B. Before final connections are made in the piping systems, all piping shall be blown out with air and then completely washed out with cleaning compounds. The systems shall be flushed for complete removal of all foreign materials. Furnish all temporary connections, equipment, and valves required for this purpose.

C. After flushing, sterilize the domestic water systems with an approved chlorinating agent to provide a dosage on not less than fifty (50) ppm. After minimum contact period of twenty-four (24) hours, the system shall be flushed with clean water until the residual chlorine is no greater than the city water.

D. Refer to specific sections for testing requirements.

3.12. TESTS:

A. Tests shall be complete prior to final inspection and prior to covering with insulation or earth.

B. All pressure tests shall be charted using a stripe chart recorder with enough paper for the duration of the test shown. Refer to other specifications for additional requirements. The test results shall include test run, test date, person doing the testing, and Engineer or authority having jurisdiction signature.

C. All tests shall be witnessed and approved by the Engineer and the local authority having jurisdiction before covering or insulating. Provide Engineer with a minimum of [twenty -four (24) OR forty-eight (48)] hour written notice prior to any testing.

D. Test all storm drain, vent and waste lines with standing water test of twelve (12) feet of head. Test to be held for a minimum of six (6) hours.

E. Hydraulically test all heating water, steam piping, condensing water, chilled water, and drain piping before connecting to the units at one-hundred-fifty (150) psig hydrostatic pressure. Test to be held for a minimum of six (6) hours.

F. Hydraulically test all domestic cold, hot and recirculating hot water and soft water copper service lines at two-hundred (200) psig. Test to be held for a minimum of six (6) hours.

G. Hydraulically test all domestic cold, hot and recirculating hot water and soft water lines as follows:

1. While still accessible all piping shall be water pressure/leak tested to the manufacturer's standards. The Contractor shall pressure test the Aquatherm per the Manufacturer' requirements and per their form. Copies of these completed form are to be submitted for review by the Engineer and be included in the Operations and Maintenance Manuals.
2. Tests shall be carried out using water. The test pressure shall be as indicated in the pressure leak testing procedures required by the manufacturer.
3. Any leaks detected shall be repaired at the contractor's expense by removing the leaking part and replacing with new parts welded per the pipe manufacturer's guidelines.

H. Hydraulically test all PROPRESS FITTING domestic cold, hot and recirculating hot water and soft water service lines as follows:
1. Hydraulically test lines at eighty-five (85) psig to allow seating of the ProPress fitting's gaskets.
2. Gasket seating test to be held for a minimum of one (1) hour.
3. Then hydraulically test lines at two-hundred (200) psig.
4. Full hydraulic test to be held for a minimum of six (6) hours.

I. Refrigerant Piping
1. Leak test the system by charging the system to a pressure of ten (10) psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to five-hundred-fifty (550) psig with dry nitrogen. Seal any leaks that may be found and retest. Replace any mechanically attached fittings that leak with new fittings and retest.

2. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise

the system pressure to 2 psig with refrigerant and remove the vacuum pump.

J. Hydraulically test all medical gas lines per NFPA 99 requirements.

K. Hydraulically test all RO, DI and DIR piping lines at one-hundred-fifty (150) psig and hold for six (6) hours.

L. Hydraulically test fire protection at two-hundred (200) psig. Test to be held for a minimum of six (6) hours.

M. Medical Gases: refer to Section 22 60 13 for testing requirements.

N. Air Pressure test all gas lines under air pressure at sixty (60) psig or one and one-half (1-1/2) time working pressure, whichever is greater. Test to be held for a minimum of twenty-four (24) hours.

O. Air Pressure test all duct systems to one and one-half (1-1/2) times the SMANCA designated pressure rating. Test to be held for a minimum of six (6) hours.

P. The satisfactory operation of blowers, pumps and other equipment with moving parts shall be demonstrated to the Engineer. Equipment without movable parts shall have pressure or other tests performed by the Contractor to demonstrate satisfactory operation.

Q. Furnish all instruments, pumps, blowers and equipment required for the testing.

R. Provide written approved copies of these test reports for inclusion on the Operations and Maintenance Manuals and submit one copy to the Mechanical Engineer.

## 3.13. PAINTING

A. Surfaces of all equipment and material not provided with a factory finish coat shall be thoroughly cleaned, primed (if not factory primed) and finish coated with a high-quality alkyd industrial enamel of a color chosen by the Owner.

## 3.14. SPECIAL OPENINGS

A. The contractor shall attempt to schedule delivery of all large equipment requiring special openings for installation prior to enclosing of area. Where this is not possible written notice of required openings which must be provided shall be listed by size and location and submitted to the primary

Contractor prior to enclosing of areas involved. Work required to construct openings and the associated cost of enclosing them shall be done at no additional cost to the Owner.

3.15. PLACING IN OPERATION

A. All ducts, pipes, equipment, controls, hangers and supports shall be cleaned of plaster and other foreign debris.

B. Before final acceptance, all strainers shall be thoroughly cleaned or replaced, all bearings shall be oiled or greased, and all drains shall be cleaned out and primed. All permanent filters shall be cleaned; throwaway type filters shall be replaced with new filters.

C. The systems shall be placed in operation.

D. The contractor shall verify that all controls are set to meet operating conditions specified.

1. Example: Boiler operating control set at 200$^{o}$ F. Limit control set at 220$^{o}$ F.

E. The Contractor shall verify that all pieces of equipment are operable and that all sequences of controls are being met.

F. Contractor to adjust seating through the first (1$^{st}$) year as required by Engineer.

3.16. BALANCING, TESTING AND ADJUSTING THE MECHANICAL SYSTEMS

A. Balancing the mechanical systems shall be part of this contract, refer to subsequent mechanical specification section for details. This Contractor is to include in their bid the cost of balancing, testing and adjusting.

3.17. OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall prepare and provide a minimum of one (1) hard copy and a CD version of operating and maintenance manuals. Contractor shall deliver these sets to the Engineer for approval. Each manual shall be in a ring binder and shall be indexed with dividers for each section. Delivery of required documents is a condition of final acceptance.

B. Each manual shall contain, but not limited to, the following general sections:

1. Certificates of acceptance from the inspecting authorities including approval of backflow preventer installation and certification,

2. Waiver of all liens if required by Division 1 requirements,
3. Warranties with starting dates and end dates for each pieces of equipment and/or for each system (warranties shall begin on date of substantial completion and acceptance by the Owner),
4. Names, telephone and fax numbers and addresses of all subcontractors, vendors, manufacturer's representatives, and warranties providers, (On Contractor's letterhead stationary),
5. Certification letters from each Contractor that each system furnished and installed by that contractor and/or subcontractors is started-up, balanced, adjusted and checked for proper operation in accordance with the intent of the contract documents,
6. Spare parts lists for each piece of equipment,
7. Lubrication charts showing type of lubrication and application methods and frequencies,
8. Filter cleaning or replacement schedule (On Contractor's letterhead stationary),
9. Preventative maintenance schedule for checking all items such as belt drives, safety controls, oil and refrigerant charges, and seasonal changer over recommendations. Cleaning of all strainers, traps, coils, tower pans, tubes, sprays, etc. (on Contractor's letterhead stationary),
10. Normal operating instructions including a sequence of operations (on Contractor's letterhead stationary),
11. Instructions as to procedures to be followed for emergency situations, such as alarms or safety items being tripped. (on Contractor's letterhead stationary),
12. Instruction on who to call for service during guarantee period, (on Contractor's letterhead stationary),
13. Include copies of all start-up reports on the equipment.
14. Include copies of Valve Tag Lists: listing to include valve number, system, function (isolation of control), location, and type of valve.
15. Complete AS-BUILT temperature control diagrams including written control descriptions, system sequence of operations, schematics, parts or component lists, and operating instructions shall also be provided. In addition, one copy of the schematic pneumatic and/or electrical control diagrams shall be framed under glass and mounted on an equipment room wall in the vicinity of the installed equipment. Coordinate with requirements in the control [and commissioning] specifications
16. Approved copy of the Testing, Adjusting and Balancing Reports,
17. Copies of As-Built drawings on reproducible vellum as produced by a Xerox or photographic process or on CD or DVD and,
18. Copies of all **APPROVED** shop drawing submittals including nameplate date, design parameters, name, telephone and fax numbers, address of vendor, manufacturer's representative and warrantee provider.

C. Approval will not be given for final payment until the tests, balancing, and operating instruction portions have been completed.

D. Coordinate with commissioning specifications for additional requirements concerning operations and maintenance instructions.

3.18. INSTRUCTIONS TO THE OWNER

A. Contractor shall instruct the Owner's operating personnel in the operations and maintenance of all mechanical systems and equipment. There shall be a minimum of eight (8) hours of training. Contractor shall furnish any special servicing tools required for maintenance.

B. Contractor shall conduct a demonstration of 'the installation upon completion and final acceptance of the work. There shall be a minimum eight (8) hour demonstration. Prior to this all work shall have been completed, tested, balanced and placed in operation. Qualified personnel must be present at the demonstration to operate all the systems and prove the performance of the equipment. The schedule for this demonstration shall be coordinated with the Engineer.

C. These sessions shall be video-taped, and these tapes/CDs turned over to the Owner for their use.

3.19. INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated below shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. IN each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory to the Manufacturer's Representative and Engineer.

B. Each equipment supplier's representative shall furnish to the Engineer a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated satisfactorily.

1. Equipment Requiring Installation Check:
   a). Reduced Pressure Backflow Preventer at make up water assemblies
   b). Cooling Towers

c). All Pumps
d). Heating Water Boilers

3.20. OPERATIONAL TEST

A. After completion of testing, adjusting and balancing work (see related specification section) the Contractor shall perform an operating test covering all equipment furnished and installed under Division 22. This test shall cover a period of not less than 24 hours. The Contractor shall have all of his equipment operating and check all equipment for adjustments. The Contractor will instruct the Owner's operating personnel in the operation and maintenance the system following this operational test. The operational test shall be a demonstration of the operation of the systems in all specified modes. Operational test shall be conducted by the Contractor with the assistance of the Testing and Balancing Sub-Contractor. Tests as required shall be conducted in the presence of the Owner and the Mechanical Engineers. Coordinate operation testing with requirements in other specification sections.

3.21. INTERRUPTING SERVICES

A. The Contractor shall coordinate the installation of all work within the building in order to minimize interference with the operation of existing mechanical, plumbing, and utility systems during construction. Connections to existing systems requiring the interruption of services within the building shall be carefully coordinated with the Owner to minimize system downtimes. Requests for the interruption of existing services shall be submitted to the Owner and/or Engineer in writing a minimum of two (2) weeks before the scheduled date. Absolutely no interruption of the existing services will be permitted without the written approval of the Owner and/or Engineer.

3.22. CONSTRUCTION POWER

A. Electrical power for conducting construction activities shall be acquired as indicated by Engineer and carefully coordinated with Owner's personnel.

END OF SECTION 22 05 00

# SECTION 22 05 13 – BASIC MECHANICAL MATERIALS AND METHODS

## PART 1 – GENERAL

### 1.1. RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and the Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2. SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Division 21, 22, and 23 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete equipment base construction requirements.
3. Equipment nameplate data requirements.
4. Labeling and identifying mechanical systems and equipment is specified in Section 23 05 53 "Mechanical Identification."
5. Nonshrink grout for equipment installations.
6. Field-fabricated metal and wood equipment supports.
7. Installation requirements common to equipment specification Sections.
8. Cutting and patching.
9. Touchup painting and finishing.

B. Pipe and pipe fitting materials are specified in piping system Sections.

### 1.3. DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed Interior Installations: Concealed from view and protected from

physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. Wherever the word(s) “provide”, “furnish”, “install” and/or the like is/are used; it is to be defined as and understood to require that the Contractor shall provide the item/system(s) totally and completely furnished, installed, and fully operable and useable for its/their intended purpose(s) unless specifically noted otherwise in the contract documents.

1.4. SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for following piping specialties:

1. Mechanical sleeve seals.

C. Samples of color, lettering style, and other graphic representation required for each identification material and device.

D. Coordination drawings for access panel and door locations.

E. Prepare coordination drawings according to Division 1 Section "Submittals" to a 1/4 inch equals 1 foot (1:48) scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:

1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:
   a) Planned piping layout, including valve and specialty locations and valve stem movement.
   b) Planned duct systems layout, including elbow radii and duct accessories.
   c) Clearances for installing and maintaining insulation.
   d) Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.

e) Equipment service connections and support details.
f) Exterior wall and foundation penetrations.
g) Fire-rated wall and floor penetrations.

2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

## 1.5. QUALITY ASSURANCE

A. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

B. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

## 1.6. DELIVERY, STORAGE AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7. SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in this Section."

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.1. PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2. JOINING MATERIALS

A. Refer to individual piping system specification Sections in Divisions 21, 22, and 23 for special joining materials not listed below.

B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.

a) Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
b) Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.

2. ASME B16.20 for grooved, ring-joint, steel flanges.

3. AWWA C110, rubber, flat face, 1/8-inch-thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

E. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.

F. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
2. BAg1: Silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

I. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.

2. Followers: ASTM A 47 (ASTM A 47M), Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3. PIPING SPECIALTIES

A. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at an 180$^{o}$ F temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   a) Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225$^{o}$F temperature.
7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225$^{o}$F temperature.

B. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber-sealing elements to expand when tightened.

C. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized,

plain ends.

3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
   a) Penetrating Pipe Deflection: 5 percent without leakage.
   b) Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket, conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
   c) Pipe Sleeve: AWWA C151, ductile-iron pipe.
   d) Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.
5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.
   a) Underdeck Clamp: Clamping ring with setscrews.

## 2.4. GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

## 2.5. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

# PART 3 – EXECUTION

## 3.1. PIPING SYSTEMS--COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Divisions 22 and 23 specify piping installation requirements unique to the piping system.

B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

C. Coordinate excavation, trenching, and backfilling requirements necessary to accomplish mechanical work.

D. Coordinate the thickness of the wall to accommodate the concealed piping and its associated insulation, if required. I.E., 4 inch sewer or vent line required a 6 inch thick wall.

E. Install piping at indicated slope.

F. All pipes, ducts, and conduit shall be hung as high as possible. Electrical work shall be hung above other work.

G. Exact location of electric outlets, piping, ducts, and the like shall be coordinated to avoid interferences between lighting fixtures, piping, ducts, structural elements, and similar items.

H. Install components having pressure rating equal to or greater than system operating pressure.

I. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

J. Install piping free of sags and bends.

K. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

L. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

M. Install piping to allow application of insulation plus 1-inch clearance around insulation.

N. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

O. Install fittings for changes in direction and branch connections.

P. Install couplings according to manufacturer's printed instructions.

Q. Sleeves are required for core drilled holes.

R. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

S. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.
   a) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 4 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
2. Build sleeves into new walls and slabs as work progresses.
3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a) Steel Pipe Sleeves: For pipes smaller than 6 inches.
   b) Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
   c) Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 4 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."
      (1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."

T. Above Grade, Exterior Wall, and Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6 inches.
2. Install cast-iron wall pipes for sleeves 6 inches and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

U. Exterior Wall, and Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals. Make penetration weatherproof.

V. Protection of Penetrations

1. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

2. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

3. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Division 7 Section "Firestopping."

W. Verify final equipment locations for roughing in.

X. Refer to equipment specifications in other Sections for roughing-in requirements.

Y. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
   a) Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should

be threaded into joint.

b) Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).

c) Align threads at point of assembly.

d) Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.

e) Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.

7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

8. No union shall be placed in a location which will be inaccessible after completion of the project.

9. A union or flange shall be installed so equipment may be readily disconnected:

a) On each side of each control valve, regulator, and similar items.

b) On one side of each check valve and each trap.

c) At all connections to pieces of equipment such as chillers, boilers, pumps, compressors, tanks, and similar items

Z. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.

2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3. Dry Piping Systems (Gas): Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems (Water): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

AA. Access To Valves

1. Valves, bearings, and other operating parts located in equipment rooms, installed more than 6'-6" to center line above the floor or

platform or are not readily accessible due to the proximity of the other equipment shall be provided with chain wheels, extension stems, extension oil pipes, and similar devices. The above provision does not apply to finished spaces.

BB. Drip Pans

1. Provide and install auxiliary drain pans under suspended air handlers and blower coils per code. Route 3/4" copper condensate drain from auxiliary drain pan to nearest service sink or indirect into nearest floor drain.
2. Provide drip pans under fluid conducting piping, including steam supply piping, which runs over the following electrical work:
   a) Switchgear
   b) Busways
   c) Motor Starters
   d) Electrical Panels and Enclosures
   e) Disconnect Switches
   f) Base mounted pump drain pans
3. Pans shall be made of a minimum 22-gauge galvanized steel. Pans shall be 2inches deep, with hemmed top edges, and shall extend 6 inches beyond the equipment below. Pans shall be kept as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.
4. Each pan shall be pitched to drain connection, and a 3/4 inch or larger copper drain pipe shall be piped to discharge where shown on drawings, or if not shown, to discharge over nearest available open drain; open end sluices discharging to intercepting pans will not be accepted.

3.2. EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment, giving right-of-way to piping systems installed at a required slope.

F. Provide means for making adjustments to mechanical equipment without bending, springing, or otherwise deforming any part (items such as belt drives, damper linkages, and pulleys). Adjustments shall incorporate set-screws or similar means for positive settings.

3.3. PAINTING AND FINISHING

A. Refer to Division 09 00 00 Section "Painting" for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4. CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3,000-psi, 28-day compressive strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.5. ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.6. ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7. DEMOLITION

A. Coordinate demolition of system with phasing plans.

B. Disconnect, demolish, and remove work specified under Divisions 22, and 23 and as indicated on the drawings.

C. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

D. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

E. Abandoned Work: Cut and remove buried pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap and patch surface to match existing finish.

F. Removal: Remove indicated equipment from the Project site.

G. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.8. CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.9. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

## 3.10. GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 22 05 13

# SECTION 22 11 16 – PLUMBING PIPING

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Pipe and pipe fittings.

B. Valves.

C. Domestic water piping system.

D. Natural gas piping system.

### 1.2. RELATED SECTIONS

A. Section 23 05 53 - Mechanical Identification.

B. Section 23 07 16 – Hydronic Piping Insulation.

C. Section 22 11 19 - Plumbing Specialties.

### 1.3. REFERENCES

A. ANSI B31.1 - Power Piping.

B. ANSI B31.2 - Fuel Gas Piping.

C. ANSI B31.9 - Building Service Piping.

D. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

E. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.

F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

G. ASTM B32 - Solder Metal.

H. ASTM B42 - Seamless Copper Pipe.

I. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

J. NFPA 54 - National Fuel Gas Code.

1.4. SUBMITTALS

A. Submit under provisions of Section 01 33 00 and 22 05 00.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.5. PROJECT RECORD DOCUMENTS

A. Submit under provisions of Sections 01 78 39 and 22 05 00.

B. Record actual locations of valves.

1.6. OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Sections 01 78 23 and 22 05 00.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7. QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

1.8. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by the manufacturer.

1.9. REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Texas plumbing code.

B. All items shall be lead free per the Reduction of Lead in Drinking Water Act 2014.

C. Conform to applicable code for installation of backflow prevention devices.

D. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

E. At the end of warranty period the Contractor shall perform a Backflow Inspection per the requirements of the State of Texas Plumbing Codes and shall turn a copy over to the Owner and a copy to State of Texas per their requirements.

1.10. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Sections 01 60 00 and 22 05 00.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11. ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.12. EXTRA MATERIALS

A. Furnish under provisions of Sections 01 78 46 and 22 05 00.

B. Provide two repacking kits for each type and size valve.

PART 2 – PRODUCTS

2.1. WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, Grade 95TA. The item shall be lead free.

2.2. NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
2. Joints: NFPA 54, threaded or welded to ANSI B31.1, ANSI B31.2, ANSI B31.9, and ASME Sec 1. The item shall be lead free.

2.3. PROPANE GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
2. NFPA 54, threaded or welded to ANSI B31.1, ANSI B31.2, ANSI B31.9, and ASME Sec 1. The item shall be lead free.

2.4. FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under:

1. Ferrous pipe: 150 psig malleable iron threaded unions.
2. Copper tube and pipe: 150 psig bronze unions with soldered joints. The item shall be lead free.

B. Pipe Size Over 2 Inches:

1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.5. BALL VALVES

A. Manufacturers:

1. NIBCO.

2. Milwaukee.
3. Grinnell Corp.
4. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Up to and including 2 Inches: Bronze two piece body, stainless full ported steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, solder or threaded ends with union. The valve assembly shall be lead free.

2.6. PLUG VALVES

A. Manufacturers:

1. Grinnell Corp.
2. Homestead Valve Division.
3. Nordstrom
4. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Up to and including 2 Inches: Bronze body, bronze tapered plug, greaseable, teflon packing, threaded ends. The valve assembly shall be lead free.

C. Over 2 Inches: Cast iron body and plug, greaseable, teflon packing, flanged ends. Packing shall be replaceable under pressure. The valve assembly shall be lead free.

2.7. SWING CHECK VALVES

A. Manufacturers:

1. NIBCO.
2. Milwaukee.
3. Grinnell Corp.
4. Red-White Valve Corp.
5. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Up to and including 2 Inches: Bronze swing disc, solder or screwed ends. The valve assembly shall be lead free.

C. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends. The valve assembly shall be lead free.

2.8. WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Wilkins/Zurn.
2. Watts Model.
3. Febco Model.
4. Beeco Model.
5. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, [threaded] [and single union] [double union] ends. The valve assembly shall be lead free.

C. Over 2 Inches: Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged. The valve assembly shall be lead free.

2.9. RELIEF VALVES

A. Manufacturers:

1. Bell & Gossett.
2. Sparco Inc.
3. Watts Regulator Corp.
4. Wilkins.
5. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled. The valve assembly shall be lead free.

2.10. STRAINERS

A. Manufacturers:

1. Wilkins.
2. Grinnell Corp.
3. Watts Regulator.
4. Mueller Steam Specialty.
5. Hoffman.
6. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen. The item shall be lead free.

2.11. BACKFLOW PREVENTER VALVES

A. Reduced Pressure Backflow Preventer

1. Manufacturers:
   a) Wilkins/Zurn Model 375XL.
   b) Watts Model 909.
   c) Febco Model 825.
   d) Beeco Model 12.
   e) Danfoss RPZ.
   f) Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.
2. Under 1-1/2 Inches: ANSI/ASSE 1013, and AWWA C506; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two OS&Y gate valves, strainer, and four test cocks. The valve assembly shall be lead free.

PART 3 – EXECUTION

3.1. EXAMINATION

A. The drawings indicate the locations, type and sizes of various utilities within the site where known. These utilities are indicated as accurately as possible. If the Contractor encounters any utilities or differing conditions during construction, which are not shown on the drawings, they shall request in writing for written instructions from the Architect and/or Engineer

B. Contractor shall verify location, size, elevation, pressure and any other pertinent data of the existing utilities. The Contractor shall provide a written report with drawings indicating this existing utilities information, such as utility locations and sewer invert information.

3.2. PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Prepare, clean, and prime pipe, fittings, supports, and accessories not pre-finished and ready for finish painting. Refer to Section 09 90 00.

J. Install valves with stems upright or horizontal, not inverted.

K. Provide one plug valve wrench for every ten plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench with set screw.

L. Pipe vents from gas pressure reducing valves or regulator to outdoors and terminate in weather proof hood.

M. Piping shall be supported at 6 feet on center and at both sides of changes in direction with factory fabricated roof supports. Flash supports into roof per roofing manufacturer recommendations.

3.4. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or

smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

3.5. APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install ball or butterfly valves for throttling, bypass, or manual flow control services.

F. Provide spring loaded check valves on discharge of water pumps.

G. Provide plug valves in Natural and Propane gas systems for shut-off service.

3.6. ERECTION TOLERANCES

A. Slope water piping and arrange to drain at low points.

END OF SECTION 22 11 16

# SECTION 23 05 13 – MOTORS

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Sections, including single phase and three phase electric motors.

### 1.2. RELATED SECTIONS

A. Section 26 05 03 – Equipment Wiring Systems: Electrical characteristics and wiring connections.

### 1.3. REFERENCES

A. Section [01 45 00 – Quality Control:] [01 42 19 – Reference Standards:] Requirements for references and standards.

B. AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

C. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings.

D. NEMA MG 1 – Motors and Generators.

E. NFPA 70 – National Electrical Code.

F. UL 674 – UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

G. UL 1836 – UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

### 1.4. REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

### 1.5. DELIVERY, STORAGE, AND PROTECTION

A. Section 22 05 13 – Basic Mechanical Material and Methods: Transport, handle, store, and protect products.

B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.6. WARRANTY

A. Section 01 70 00 – Contract Closeout

B. Provide five year manufacturer warranty for motors larger than 1 horsepower.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. General Electric

B. Baldor

C. Magnetek

D. Reliance

E. Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.

2.2. GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.

B. Single Phase Motors: PSC where available.

C. Electrical Service:

1. Refer to drawngs for required electrical characteristics.

D. Open drip-proof type except where specifically noted otherwise.

E. Design for continuous operation in 40$^{o}$C environment.

F. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

G. Explosion-Proof Motors: UL approved for hazard classification.

H. Visible Nameplate: Indicating manufacturer's name and model number, motor

horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.

I. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide [threaded] conduit connection in end frame.

2.3. THREE PHASE POWER – SQUIRREL-CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B energy efficient motors.

E. Insulation System: NEMA Class B or better.

F. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

H. Sound Power Levels: To NEMA MG 1.

I. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

J. Nominal Efficiency: To NEMA MG 1, energy efficient for motor sizes one (1) horsepower and larger.

PART 3 – EXECUTION

## 3.1. INSTALLATION

A. Section 01 45 00 – Quality Control: Manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 23 05 13

# SECTION 23 05 53 – MECHANICAL IDENTIFICATION

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Tags

B. Pipe Markers.

### 1.2. RELATED SECTIONS

A. Section 09 91 00 – Painting: Identification painting.

### 1.3. REFERENCES

A. Section 01 45 00 – Quality Control and 01 42 19 – Reference Standards: Requirements for references and standards.

B. ANSI/ASME A13.1-2015 – Scheme for the Identification of Piping Systems.

### 1.4. SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Section 22 05 00 – General Mechanical Requirements for submittals.

C. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

D. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

E. Product Data: Provide manufacturers catalog literature for each product required.

### 1.5. SUBMITTALS FOR INFORMATION

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Manufacturer's Instructions: Indicate installation instructions, special procedures, and installation.

### 1.6. SUBMITTALS AT PROJECT CLOSEOUT

A. Section 01 70 00 – Contract Closeout and 01 78 23 – Operation and

Maintenance Data: Procedures for submittals.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers, associated system, function, normal position, and type.

C. Valve Tag Chart.

1.7. EXTRA MATERIALS

A. Sections 01 70 00 – Contract Closeout and 01 78 23 – Operation and Maintenance Data.

PART 2 – PRODUCTS

2.1. VALVE TAGS

A. Metal Tags:

1. Manufacturers:
   a) Seton.
   b) USA Brady.
   c) Panduit.
   d) Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.
2. Brass, Aluminum, or Stainless Steel with stamped letters; tag size minimum 1-1/2 inches diameter with smooth edges.

B. Tag Chart: Typewritten letter size list in anodized aluminum frame and plastic laminated.

2.2. NAMEPLATES AND LABELS

A. Manufacturers:
1. Seton.
2. USA Brady.
3. Panduit
4. Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.

B. Nameplates: Engraved three-layer laminated plastic, white letters on black background.

C. Locations:

1. Each mechanical equipment.

D. Letter Size:

1. 1/8-inch letters for identifying individual equipment and loads.
2. 1/4-inch letters for identifying grouped equipment and loads.

E. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches and receptacles and control device stations.

2.3. PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:
   a) Seton.
   b) USA Brady.
   c) Panduit
   d) Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.
2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Manufacturers:
   a) Seton.
   b) USA Brady.
   c) Panduit
   d) Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.
2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 – EXECUTION

3.1. PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2. INSTALLATION

A. Section 01 45 00 – Quality Control: Manufacturer's instructions.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Identify valves in main and branch piping with tags.

G. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 23 05 53

# SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Testing, adjustment, and balancing of hydronic systems.

B. Measurement of final operating condition of HVAC systems.

C. Sound measurement of equipment operating conditions.

D. Vibration measurement of equipment operating conditions.

### 1.2. RELATED SECTIONS

A. Section 01 30 00 – Administrative Provisions: Inspection and testing allowances and 22 05 00 – General Mechanical Requirements.

B. Section 01 40 00 – Quality Control: Testing laboratory services. Employment of testing agency and payment for services.

### 1.3. REFERENCES

A. AABC – National Standards for Total System Balance.

B. ASHRAE 111 – Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

C. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. SMACNA – HVAC Systems Testing, Adjusting, and Balancing.

### 1.4. SUBMITTALS

A. Submit under provisions of Sections 01 33 00 and 22 05 00

B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

C. Field Reports: Submit under provisions of Section 01 40 00 and 22 05 00.

D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

G. Provide reports in soft cover, letter size, binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

H. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

I. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, forms prepared following ASHRAE 111, NEBB forms, forms containing information indicated in Schedules.

1.5. PROJECT RECORD DOCUMENTS

A. Submit under provisions of Sections 01 70 00 and 22 05 00.

B. Record actual locations of flow measuring stations, balancing valves and rough setting.

1.6. QUALITY ASSURANCE

A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE 111, or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

B. Maintain one copy of each relevant document on site.

1.7. QUALIFICATIONS

A. Agency: A independent company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience certified by AABC or NEBB. The company is to have no affiliation with the mechanical, controls or EMCS contractor.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor and registered Professional Engineer experienced in performance of this Work and licensed in the State of TEXAS.

C. The Balancing Contractor shall be independent of the project and shall have on other work on this project. For example, the Temperature Control Contractor cannot also be the Balancing Contractor for this project.

D. The Balancing Contractor shall be under the Contractor only.

1.8. PRE-BALANCING CONFERENCE

A. Convene a MANDATORY meeting two weeks prior to commencing work of this section, under provisions of Section 01 30 00A

1.9. SEQUENCING

A. Sequence work under the provisions of Section 22 05 00.

B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.10. SCHEDULING

A. Schedule work under the provisions of Sections 01 30 00 and 22 05 00.

B. Review the contract drawings and specifications and the approved shop drawings to obtain necessary equipment information for the report.

PART 2 – PRODUCTS

2.1. Not Used

PART 3 – EXECUTION

3.1. EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Thermostats are set at design space temperature for room usage.
4. Hydronic systems are flushed, filled, and vented.
5. Pumps are rotating correctly.
6. Proper strainer baskets are clean and in place.
7. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies noted during performance of services, which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.2. PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

C. Review the contract drawings and specifications and the approved shop drawings to obtain necessary equipment information for the report.

3.3. INSTALLATION TOLERANCES

A. Hydronic Systems: Adjust to within plus 10 percent or minus 0 percent of design.

3.4. ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5. WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer

elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.6. SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

1. HVAC Heating Water Boilers and System (Boilers, Pumps, Fans and Flow Devices)
2. Cooled Chilled Water System (Air Cooled Chiller, Pumps, Flow Devices, Valves)
3. Verify all sequences of operation.
4. Verify all EMCS operation including points.
5. HVAC Pumps
6. Water Tube Boilers
7. Water Chillers
8. Blow Through Cooling Tower

B. Report Forms

1. Title Page:
   a) Name of Testing, Adjusting, and Balancing Agency
   b) Address of Testing, Adjusting, and Balancing Agency
   c) Telephone and fax numbers of Testing, Adjusting, and Balancing Agency
   d) Project name
   e) Project location
   f) Project Architect
   g) Project Engineer
   h) Project Contractor
   i) Project altitude
   j) Report date
2. Summary Comments:
   a) Design versus final performance
   b) Notable characteristics of system
   c) Description of systems operation sequence

d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
e) Nomenclature used throughout report
f) Test conditions
g) Schematic Drawing showing locations of tested items.

3. Instrument List:
   a) Instrument
   b) Manufacturer
   c) Model number
   d) Serial number
   e) Range
   f) Calibration date
4. Electric Motors:
   a) Manufacturer
   b) Nameplate Data
   c) Model/Frame
   d) HP/BHP
   e) Phase, voltage, amperage; nameplate, actual, no load
   f) RPM
   g) Service factor
   h) Starter size, rating, heater elements
   i) Sheave Make/Size/Bore
5. Pump Data:
   a) Identification/number
   b) Manufacturer
   c) Nameplate data
   d) Size/model
   e) Impeller
   f) Service
   g) Design flow rate, pressure drop, BHP
   h) Actual flow rate, pressure drop, BHP
   i) Discharge pressure
   j) Suction pressure
   k) Total operating head pressure
   l) Shut off, discharge and suction pressures
   m) Shut off, total head pressure
   n) Provide motor information as noted above.
6. Chillers:
   a) Identification/number
   b) Manufacturer
   c) Nameplate Data
   d) Capacity
   e) Model number
   f) Serial number
   g) Evaporator entering water temperature, design and actual
   h) Evaporator leaving water temperature, design and actual

i) Evaporator pressure drop, design and actual
j) Evaporator water flow rate, design and actual
k) Condenser entering water temperature, design and actual
l) Condenser pressure drop, design and actual
m) Condenser water flow rate, design and actual
n) Provide motor information as noted above.

7. Cooling Tower:
   a) Tower identification/number
   b) Manufacturer
   c) Nameplate Data
   d) Model number
   e) Serial number
   f) Rated capacity
   g) Chiller served
   h) Entering air WB temperature, specified and actual
   i) Leaving air WB temperature, specified and actual
   j) Ambient air DB temperature
   k) Condenser water entering temperature
   l) Condenser water leaving temperature
   m) Condenser water flow rate
   n) Fan RPM
   o) Provide motor information as noted above.
   p) Provide pump information as noted above.

END OF SECTION 23 05 93

# SECTION 23 06 20 – HYDRONIC SPECIALTIES

## PART 1 – GENERAL

### 1.1. SUMMARY

A. Section includes pressure gages and pressure gage taps, thermometers and thermometer wells, Section also includes, air vents, strainers, pump suction fittings, combination fittings, flow indicators, controls, meters.

### 1.2. RELATED SECTIONS:

A. Section 23 21 13 – HYDRONIC PIPING: Execution requirements for piping connections to products specified by this section.

### 1.3. REFERENCES

A. SME (American Society of Mechanical Engineers) – Boiler and Pressure Vessel Codes, SEC VIII-D – Rules for Construction of Pressure Vessels.

B. ASME B40.1 (American Society of Mechanical Engineers) – Gauges – Pressure Indicating Dial Type – Elastic Element.

C. ASTM E1 – Standard Specification for ASTM Thermometers.

D. ASTM E77 – Standard Test Method for Inspection and Verification of Thermometers.

E. ASTM A105 – Forgings, Carbon Steel, for Piping Components.

F. ASTM A126 – Grey Iron Castings for Valves, Flanges, and Pipe Fittings.

G. ASTM A216 – Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

### 1.4. SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit for manufactured products and assemblies used in this Project.

C. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.

D. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

E. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.

F. Submit electrical characteristics and connection requirements.

G. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5. CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of actual locations of components and instrumentation.

C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.6. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.7. PRE-INSTALLATION MEETING

A. Section 01 30 00 – Administrative Requirements and 22 05 00 - General Mechanical Requirements: Pre-installation meeting.

B. Convene minimum one week before commencing Work of this section.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements and 22 05 00 – General Mechanical Requirements: Product storage and handling requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.9. ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – Product Requirements and 22 05 00 – General Mechanical Requirements.

B. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.10. FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

1.11. WARRANTY

A. Section 01 70 00 – Execution Requirements and 22 05 00 – General Mechanical Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for piping specialties.

1.12. MAINTENANCE SERVICE

A. Section 01 70 00 – Execution Requirements and 22 05 00 – General Mechanical Requirements: Maintenance service.

1.13. MAINTENANCE MATERIALS

A. Section 01 70 00 – Execution Requirements and 22 05 00 – General Mechanical Requirements: Spare parts and maintenance materials.

1.14. EXTRA MATERIALS

A. Section 01 70 00 – Execution Requirements and 22 05 00 – General Mechanical Requirements: Spare parts and maintenance products.

B. Furnish two pressure gages with pulsation damper, stem type thermometers and dial thermometers.

PART 2 – PRODUCTS

2.1. PRESSURE GAGES

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. Gage: ASME B40.1, UL 393, and UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Brass or Type 316 stainless steel.
3. Dial Size: 3-1/2-inch diameter.
4. Mid-Scale Accuracy: One percent.
5. Scale: Both psi and kPa.

2.2. PRESSURE GAGE TAPS

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. Needle Valve:

1. Brass or Stainless Steel, 1 /4 inch NPT for minimum 300 psi.

C. Ball Valve:

1. Brass or Stainless Steel, 1/4 inch NPT for 250 psi.

D. Pulsation Damper:

1. Pressure snubber, brass with 1/4 inch NPT connections.
   a) Siphon:
   b) Stainless Steel, 1/4 inch NPT angle or straight pattern.

2.3. STEM TYPE THERMOMETERS

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. Thermometer: ASTM E1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.

1. Size: 9-inch scale.
2. Window: Clear Lexan.
3. Stem: Brass, 3/4-inch NPT, 3-1/2 inch long.
4. Accuracy: ASTM E77 2 percent.

5. Calibration: Both degrees F and degrees C.

2.4. THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5. TEST PLUGS

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. 1/4-inch NPT brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200$^{o}$ F.
2. Nordel core for temperatures up to 350$^{o}$ F.
3. Viton core for temperatures up to 400$^{o}$ F.

C. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a) Two 3-1/2-inch diameter pressure gages.
   b) Scale range: As required for the project’s ranges.
   c) Two gage adapters with 1/8-inch probes.
   d) Two 1-1/2-inch dial thermometers.
   e) Scale range: As required for the projects ranges.
   (1) Scale range: Both degrees F and degrees C as required for the project’s ranges.

2.6. AIR VENTS

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. Manual Type: Short vertical sections of 2inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.

2.7. BRAIDED HOSE

A. The twenty-four (24) inch fire-rated flexible hose assembly has a braided stainless steel outer band with EPDM (ASTM E 84-10 EPDM) inner tube and brass or steel threaded fittings. Hose is batch tested to 450 PSI. Limited Warranty 36 months - hoses and components. IMI Flow Design F333.2 H3 or approved equal.

2.8. STRAINERS

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. Size2 inch and Under:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9. PUMP SUCTION FITTINGS

A. Manufacturers:

1. Taco.
2. Bell & Gossett.
3. Paco.
4. Armstrong
5. Substitutions: Not Permitted.

B. Fitting: Angle pattern, cast-iron body. Threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger. Rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blow-down tapping in bottom, gage tapping in side.

PART 3 – EXECUTION

3.1. INSTALLATION

A. Furnish materials in accordance with State of Texas Public Work's standards.

B. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

C. Install gage taps in piping

D. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

F. Provide instruments with scale ranges selected according to service with largest appropriate scale.

G. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

I. Locate test plugs adjacent thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps and as defined in Section 23 09 23.

J. Install manual air vents at system high points.

K. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

L. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

M. Support pump fittings with floor mounted pipe and flange supports.

3.2. FIELD QUALITY CONTROL

A. Section 01 70 00 – Execution Requirements: Testing, adjusting, and balancing.

3.3. CLEANING

A. Section 01 70 00 – Execution Requirements: Requirements for cleaning.

3.4. PROTECTION OF INSTALLED CONSTRUCTION

A. Section [01 70 00 – Execution Requirements: Requirements for protecting installed construction.
B. Do not install hydronic and steam pressure gauges until after systems are pressure tested.

3.5. SCHEDULES

A. Pressure Gages.

1. Pumps.
   a) Location:
   b) Scale range:
2. Back-flow preventing device.
   a) Location:
   b) Scale range:
3. Pressure Gage Tapping Location:
   a) Control valves 3/4 inch & larger - inlets and outlets.
   b) Major coils - inlets and outlets.
   c) Heat exchangers - inlets and outlets.
   d) Chiller - inlets and outlets.
   e) Boiler - inlets and outlets.

B. Thermometers
1. Stem Type Thermometers:
   a) Boilers - inlets and outlets.
   b) Chiller - inlets and outlets.
   c) Water-zone supply and return going to campus.
2. Thermometer Socket Location:
   a) Boilers - inlets and outlets.
   b) Chiller - inlets and outlets.

END OF SECTION 23 06 20

# SECTION 23 07 19 – HYDRONIC PIPING INSULATION

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

### 1.2. RELATED SECTIONS

A. Division 7 – Firestopping.

B. Section 09 91 00 – Painting: Painting insulation jacket.

C. Section 23 05 53 – Mechanical Identification.

D. Section 22 11 16 – Plumbing Piping: Placement of hangers and hanger inserts.

E. Section 23 21 13 – Hydronic Piping: Placement of hangers and hanger inserts.

### 1.3. REFERENCES

A. Section 01 45 00 – Quality Control, 01 42 19 – Reference Standards and 22 05 00 – General Mechanical Requirements: Requirements for references and standards.

B. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (ASTM B209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]).

C. ASTM C177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

D. ASTM C195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.

E. ASTM C240 – Standard Test Methods of Testing Cellular Glass Insulation Block.

F. ASTM C449/C449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

G. ASTM C518 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

I. ASTM C552 – Standard Specification for Cellular Glass Thermal Insulation.

J. ASTM C921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

K. ASTM D2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics.

L. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

M. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

N. NAIMA National Insulation Standards.

O. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

P. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

1.4. SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals and Section 22 05 00 – General Mechanical Requirements.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5. SUBMITTALS FOR INFORMATION

A. Section 01 33 00 – Submittals: Procedures for submittals and Section 22 05 00 – General Mechanical Requirements.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6. QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.7. REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, and UL 723.

1.8. DELIVERY, STORAGE, AND PROTECTION

A. Section 01 60 00 – Material and Equipment: Transport, handle, store, and protect products.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.9. ENVIRONMENTAL REQUIREMENTS

A. Section 22 05 13 – Basic Mechanical Material and Methods: Environmental conditions affecting products on site.

B. Maintain ambient conditions required by manufacturers of each product.

C. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 – PRODUCTS

2.1. MANUFACTURER:

A. Johns Manville.

B. Owens Corning.

C. Knauf.

D. ARMAFLEX

E. Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and

Methods and Section 22 05 00 – General Mechanical Requirements.

2.2. GLASS FIBER

A. Insulation: ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.

1. 'K' value: ASTM C177, 0.24 at 75°F.
2. Maximum service temperature: 650°F.
3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:

1. ASTM C921, White Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive:

1. Compatible with insulation.

E. Insulating Cement/Mastic:

1. ASTM C195; hydraulic setting on mineral wool.

F. Fibrous Glass Fabric:

1. Cloth: Untreated; 9 oz. /sq. yd. weight.
2. Blanket: 1.0 lb. /cu ft. density.
3. Weave: 10x10.

G. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz. /sq. yd. weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

H. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

I. Outdoor Breather Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Insulating Cement:

1. ASTM C449/C449M.

2.3. HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533 [and ASTM C795]; rigid molded, asbestos free, gold color.

1. 'K' value: ASTM C177 and C518; 0.40 at 300°F.
2. Maximum service temperature: 1200°F.
3. Density: 15 lb. /cu ft.

B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement:

1. ASTM C449/C449M.

2.4. JACKETS

A. ABS Plastic:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a). Minimum service temperature: -40°F.
   b). Maximum service temperature of 180°F.
   c). Moisture vapor transmission: ASTM E96; 0.012 perm-inches.
   d). Thickness: 30 mil.
   e). Connections: Brush on welding adhesive.

B. Aluminum Jacket: ASTM B209.

1. Thickness: 0.016-inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016-inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015-inch thick aluminum.

PART 3 – EXECUTION

3.1. EXAMINATION

A. Division 01 – Coordination and Meetings: Verification of existing conditions before starting work.

B. Verify that piping has been tested before applying insulation materials.

C. Verify that surfaces are clean and dry, with foreign material removed.

3.2. INSTALLATION

A. Section 01 40 00 – Reference Standards and Codes: Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, [pump bodies,] and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140°F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and

thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
6. Support Hanger or clamp shall be located outside the insulation per schematic on drawings.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 27 00.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces [(less than 10 feet above finished floor)]: Finish ABS jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

## 3.3. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

## 3.4. SCHEDULES

A. Plumbing Systems:

1. Domestic Cold-Water Supply:
   a). Glass Fiber Insulation:
      1). Pipe Size Range: ALL.
      2). Thickness: 1.00 inch.

B. Heating Systems:
   1. Heating Water Supply and Return:
      a). Glass Fiber Insulation:
         1). Pipe Size Range: 1-1/2” and below.
         2). Thickness: 1-1/2” inch.
         3). Pipe Size Range: 2” and above.
         4). Thickness: 2” inch.
      b). Hydrous Calcium Silicate Insulation:
         1). Pipe Size Range: 1-1/2” and below.
         2). Thickness: 1-1/2” inch.
         3). Pipe Size Range: 2” and above.
         4). Thickness: 2” inch.

C. Cooling Systems:
   1. Chilled Water Supply and Return:
      a). Glass Fiber Insulation:
         1). Pipe Size Range: 1-1/2” and below.
         2). Thickness: 1-1/2” inch.
         3). Pipe Size Range: 2” and above.
         4). Thickness: 2” inch.
      b). Hydrous Calcium Silicate Insulation:
         1). Pipe Size Range: 1-1/2” and below.
         2). Thickness: 1-1/2” inch.
         3). Pipe Size Range: 2” and above.
         4). Thickness: 2” inch.

D. Dual Temperature Water Supply and Return:
   1. Change-over Piping Supply and Return
      a). Glass Fiber Insulation:
         1). Pipe Size Range: 1-1/2” and below.
         2). Thickness: 1-1/2” inch.
         3). Pipe Size Range: 2” and above.
         4). Thickness: 2” inch.
      b). Hydrous Calcium Silicate Insulation:
         1). Pipe Size Range: 1-1/2” and below.
         2). Thickness: 1-1/2” inch.
         3). Pipe Size Range: 2” and above.
         4). Thickness: 2” inch.

END OF SECTION 22 07 19

# SECTION 23 09 23 ENERGY MANAGEMENT CONTROL SYSTEM (EMCS)

## PART 1 GENERAL

### 1.1. SUMMARY

A. Section includes control equipment and software.

B. The existing EMCS system is an TAC Schneider Electric and is to be modified for the new mechanical equipment. The existing EMCS pathways between and throughout the buildings are to be reused. Refer to the Sequence of Operations and Points schedule on the drawings for further information. All components being used shall be 100% BACnet certified.

### 1.2. RELATED SECTIONS:

A. Section 23 05 53 – Mechanical Identification: Tags for control panels and components

B. Section 23 21 13 – Hydronic Piping: Tags for control panels and components. Installation of control valves, flow switches, temperature sensor wells, gages, sensors, relays, current sensors and wiring interlocks.

C. Section 23 22 16 – Hydronic Specialties: Installation of control valves, flow switches, temperature sensor wells, gages, sensors, relays, current sensors and wiring interlocks.

D. Section 23 21 23 – HVAC Pumps: Installation of control valves, flow switches, temperature sensor wells, gages, sensors, relays, current sensors and wiring interlocks.

E. Section 23 52 34 – Heating Boilers: Installation of control valves, flow switches, temperature sensor wells, gages, sensors, relays, current sensors and wiring interlocks.

F. Section 23 65 00 - Packaged Cooling Tower: Installation of control valves, flow switches, temperature sensor wells, gages, sensors, relays, current sensors and wiring interlocks.

G. Section 23 05 93 – Testing, Adjusting and Balancing

H. Section 26 05 10 – Basic Electrical Requirements

I. Section 26 05 33 – Conduit

J. Section 26 05 19 – Building Wire and Cable

K. Section 26 05 34 – Boxes

L. Section 26 27 26 – Wiring Devices

M. Section 26 05 53 – Electrical Identification

1.3. REFERENCES

A. ASME MC85.1 (American Society of Mechanical Engineers) – Terminology for Automatic Control.

B. ASTM D1693 – Environmental Stress - Cracking of Ethylene Plastics.

C. NEMA EMC1 (National Electrical Mechanical Association) - Energy Management Systems Definitions

D. NFPA 70 – National Electrical Code.

E. NFPA 90A – Installation of Air Conditioning and Ventilation Systems.

1.4. SYSTEM DESCRIPTION

A. Automatic temperature controls field monitoring and control system using field programmable units with communications to existing P.C. front end.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include modified computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Controls for air handling unit, humidifiers, differential pressure, reheat coils, and the like when directly connected to the control units.

E. Provide new control systems consisting of thermostats, control valves, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

F. Include installation and calibration, supervision, adjustments, and fine-tuning necessary for complete and fully operational system.

G. General: The control system shall be as indicated on the drawings and described in the specifications.

H. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple

users shall have access to all valid system data. An operator shall be able to log onto any work-station on the control system and have access to all.

I. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communications failure, or the loss of any other controller. The control systems shall continue to independently operate under control.

J. Communication between the control panels and all work-stations shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.

K. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

L. For Projects in which the area is to be renovated and an existing EMCS exists, the space temperature controls and equipment shall be incorporated into the existing EMCS. For New Addition(s) Projects at any given SASSLC campus and/or site which an existing EMCS exists at the campus/site, the space temperature controls and equipment shall be incorporated into the existing EMCS. Also, if the work is to be in part to an existing controlled central plant, the controls and equipment shall be incorporated to existing EMCS.

## 1.5. SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

1. The EMCS contractor shall NOT generate submittals until approved mechanical submittals have been received. This is to ensure that all interfaces (hardware /software) and coordination with equipment manufacturers is handled up front.
2. Shop Drawings:
   a). Indicate trunk cable schematic showing programmable control-unit locations and trunk data conductors.
   b). List connected data points, including connected control unit and input device.
   c). Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration diskette containing graphics.
   d). Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   e). Indicate description and sequence of operation of operating, user, and application software.
   f). Ensure terminology used in submittals conforms to ASME MC85.1.
3. All devices on submittal shop drawings shall be identified by SASSLC acronyms. These identifiers shall also be used in description of operation, in control layouts, and on data sheets for ease in cross-referencing. Final control drawings shall be

CAD generated in a format compatible with the AutoCAD system. SASSLC will provide the list to the EMCS Contractor.

4. Product Data: Submit data for each system component and software module. This includes but is not limited to the following: DDC panels, peripherals, sensors, actuators, dampers, and system components. Range and scale information for all transmitters and sensors. This sheet shall clearly indicate one device and any applicable options. Where more than one device to be used is on a single sheet, submit two sheets, individually marked
5. Detailed Bill of Material list for each panel, identifying: quantity, part number, description, and associated options.
6. Manufacturer's Installation Instructions: Submit
   a). Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   b). Contractor shall provide shop drawings and manufacturers' standards specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Engineer and Owner for conformity with the plan and specifications. Refer to section 01300 for the number of copies that are required. All shop drawings shall be done on AutoCAD version 2017 and provided to the Owner on a DVD.
   c). Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
7. Provide the Engineer sand Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
8. Submit and have approved, 30 days prior to commencing of work:
   a). A complete bill of materials of equipment to be used indicating quantity, manufacturer, and model number.
   b). A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
      1). Control Valve Schedules. This spreadsheet type schedule shall include a separate line for each valve and a column for each of the valve attributes, including: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close-off Pressure, Capacity, Valve CV, Calc CV, Design Pressure, Actual Pressure, and Actuator Type.
   c). A schedule of all control dampers: This shall include the damper size, pressure drop, manufacturer and model number.
      1). Control Damper Schedules. This spreadsheet type schedule shall include a separate line for each damper and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, and Actuator Type.
   d). Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific

product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:

1). Building Controllers
2). Custom Application Controllers
3). Application Specific Controllers
4). Operator Interface Computer
5). Portable Operator Workstation
6). Auxiliary Control Devices

9. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
10. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
11. Points list showing all system objects and the proposed English language object names.
12. Sequence of operations for each system under control. This sequence shall be specific for the uses of the control system being provided for this project. Refer to the drawings for Sequence of Operations.
    a). The EMCS contractor shall develop their own written description for each sequence of operations, to include the following:
    b). Sequences shall reference input/output and software parameters by name and description. Use actual system point names in sequences.
    c). The sequences of operations developed by the EMCS Contractor shall represent the detailed analysis needed to create actual programming code from the design documents
13. Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal. All components being used shall be 100% BACnet certified.
14. Color prints of proposed graphics with a list points for display.
15. Each submittal shall include the following information.
    a). Each submittal shall have a cover sheet with the following information provided: submittal ID number; date; project name, address, and title; FMS Contractor name, address and phone number; FMS Contractor project manager, quality control manager, and project engineer names and phone numbers
    b). EMCS riser diagram, showing all DDC controllers, operator workstations, network components, and network wiring.
    c). One-line schematics and system flow diagrams showing the location of all control devices.
    d). Points list for each DDC controller, including: Tag, Point Type, System Name, Object Name (SASSLC standard acronym), Expanded ID, Display Units, Controller Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number.
    e). Contractor's own written description for each sequence of operations, to include the following:

f). Sequences shall reference input/output and software parameters by name and description.
g). The sequences of operations provided in the submittal by the EMCS Contractor shall represent the detailed analysis needed to create actual programming code from the design documents.
h). Points shall be referenced by SASSLC acronym, including all software points such as programmable set-points, range limits, time delays, and so forth. In general, the point naming convention must follow a building-system outline – all points must have their building associated in their full point name.
i). Logic diagrams for all systems.
j). The outline level hierarchy shall start with the building name. Separate trees for floor controls and separate trees for major systems (heat exchangers, AHUs, etc.). It must be easily identifiable which AHUs server which floors or parts of floors.

B. Project Record Documents: Upon completion of installation submit one (1) hard copy of record (as-built) documents and a CD version. The documents shall be submitted for approval; prior to final completion and include:

1. Project Record Drawings – These shall be as-built versions of the submittal shop drawings. One set of magnetic media including CAD DWG or DWF drawing files shall also be provided.
   a). Testing and Commissioning Reports sand Checklists.
   b). Operating and Maintenance (O&M) Manual – These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O&M manual shall include:

C. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.

D. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

E. Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
F. Engineering, Installation and Maintenance Manual (s) that explain how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

G. A listing and documentation of all custom software created using the programming of all custom software created using the programming language including the point

database. One set of magnetic media containing files of the software and database shall also be provided.

H. One set of magnetic media containing files of all color-graphic screens created for the project.

I. A list of recommended spare parts with part numbers and supplier.

J. Complete original issue documentation, installation and maintenance information for all third-party hardware provided including computer equipment and sensors.

K. Complete original issue diskettes for all software provided including operating systems, programming language, operator work-station software, and graphics software.

L. Licenses, Guarantee, and Warrantee documents for all equipment and systems.

M. Recommend preventative maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

1.6. CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution Requirements: Closeout procedures.

B. All shop drawings will be acknowledged in writing by Engineer before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. The Contractor shall deliver 1 set of 'as-built' drawings to the consultant. The consultant will then provide 1 reproducible Mylar set and 1 set in electronic PDF electronic format, including but not limited to PDF files, to the format to the owner.

C. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.
2. Include data specified in "Submittals" in final "Record Documents" form.
3. Operation and Maintenance Data:
   a). Submit interconnection wiring diagrams complete field installed systems with identified and numbered system components and devices.
   b). Include keyboard illustrations and step-by-step procedures indexed for each operator function.
   c). Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. As built drawings must include floor plans that indicate mechanical and electrical equipment, network cable routing and control panel locations, point lists, electrical power wiring used by controls, and electrical panel location.

5. As-built point lists must be laminated and glued to the inside of all module enclosures.
6. As built drawings/documents shall be remotely uploaded to designated location by owner, and the EMCS interface shall provide a link point directing the user to remotely access the uploaded as built documents.
7. As built drawings shall clearly show the location of installed sensors (i.e. DP sensors, OA temp. sensor, building pressure sensor, etc.
8. Submittal shall include, an approved set of shop drawings generated in paragraph 1.5 above.
9. O&M Manuals:
   a). Prior to final system acceptance an Operation and Maintenance Manual shall be generated to describe function and operation of all control system components and shall include operating and trouble-shooting procedures. Submit three (3) sets of each Manual. The Manual shall be easily understood, for use by the SASSLC personnel; shall show the total integrated control system; and shall include:
   b). Include the following documentation in the Hardware Manual:
      1). General description and cut sheets for all components.
      2). Detailed wiring and installation illustrations and complete calibration procedures for each field and panel device.
      3). Complete trouble-shooting procedures and guidelines.
      4). Complete operating instructions for all systems.
   c). Maintenance Instructions: Document all maintenance and repair /replacement procedures.
   d). Calibration requirements and instructions.
   e). Include the following documentation in the DDC Software Manual:
      1). Sequence of Operations.
      2). Program Listing of Software Source Code or Flow Chart Diagrams of
      3). Programming Objects.
      4). Printed listing of controller and operator workstation database files.
      5). Software Point Name Abbreviation List including point name with SASSLC acronym, Description, Controller Where Located, Point Type and Point ID.
      6). I/O Point List; Include Point Name (SASSLC acronym), Controller Location, Point Number, Control Device, Range and Span.
      7). Printouts of all; Reports, Group Listings and Alarm Messages.
      8). It is the responsibility of the EMCS Contractor to assure that the SASSLC ENERGY MANAGERS has all current documentation regarding the installed EMCS. As part of this Scope of Work, the EMCS contractor, upon updating SASSLC ENERGY MANAGERS, will issue a Letter of Compliance to the CM/GC, acknowledging that the SASSLC FACILITIES Department has all current information, in electronic format, regarding the following:
         (a) System Engineering Manual.
         (b) System Installation Manual.
         (c) Programming Manual.

(d) Engineering and Troubleshooting Bulletins.
(e) Operator Workstation Software Manual.
(f) All other pertinent manuals published by the control system manufacturer.
(g) All manuals shall be provided in hard copy format and on a single Compact Disk (CD) as part of an on-line documentation system through the operator workstation.

9). Record Drawings including sequences of operation.

10). Complete database and software program of system in suitable electronic format will be sent by the EMCS Contractor to the SASSLC FACILITIES/ENERGY MANAGERS DEPARTMENT with a copy of the Letter of Transmittal sent to the GC/CM.

D. Certification of Product Availability: Furnish certificate from vendor of control system that all hardware and software installed on project is the most current versions available at time of installation. Expansion hardware and software shall be available during the warranty period from date of completion. Supply SASSLC with complete database of system on acceptable disks.

## 1.7. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. The Installer shall have an office within 100 miles of the project site and provide 24-hour response in the event of a customer call.

D. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

1. Underwriters Laboratories – Products shall be UL-916-PAZX listed.
2. National Electrical Code – NFPA 70.
3. Federal Communications Commission – Part J
4. ASHRAE/ANSI 135-1995 (BACnet)

E. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

## 1.8. COORDINATION

A. Coordinate all electrical power requirements with Electrical and Mechanical Contractor.

B. Make arrangements to have electrical power available at time of installation.

1.9. PRE-INSTALLATION MEETING

A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing Work of this section.

1.10. FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11. WARRANTY

A. Section 01 70 00 – Execution Requirements: Product warranties and product bonds.

B. Provide three-year manufacturer warranty for direct digital controls including all routers, gateways, building controllers, all digital control modules, all control actuators and valves, all damper motors and controls.

C. Provide three-year Contractor's warranty for installation.

1.12. MAINTENANCE SERVICE

A. Section 01 70 00 – Execution Requirements: Maintenance service.

B. Labor & materials for control system specified shall be warranted free from defects for a period of thirty-six (36) months after final completion acceptance by the Owner. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no change or reduction tin service to the Owner. The EMCS Contractor shall, free of charge, correct any defects in workmanship within four (4) hours of notification by the Owner. Response time may be extended at owner's discretion only.

C. Provide four complete inspections per year during warranty, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

D. Provide complete service of systems, including callbacks. Make minimum of 4 complete normal inspections of approximately 8 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

E. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with

the terms of this specification. The date of Owner's acceptance shall be the start of warranty.

F. Operator work-station software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.13. EXTRA MATERIALS

A. Section 01 70 00 – Execution Requirements: Spare parts and maintenance products.

B. Supply, four of each type of thermostats, four of each type of pressure sensor and four exposed sensors of each type.

1.14. SYSTEM PERFORMANCE

A. Performance Standards. The system shall conform to the following:

1. Graphic Display: The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 20 seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within 30 seconds.
3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current within the prior 60 seconds.
5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the work-station shall not exceed 45 seconds.
6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations: All work-stations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy: Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table I – Reporting Accuracy

| Measured Variable | Reported Accuracy |
|---|---|
| Space temperature | ±1 degree F |
| Ducted air | ±2 degree F |
| Outside air | ±2 degree F |
| Water temperature | ±1 degree F |
| Delta-T | ±0.25 degree F |
| Dew Point | ±2 degree F |
| Relative humidity | ±2% RH |
| Water flow | ±5% of full scale |
| Air flow (terminal) | ±5% of reading (Note 1) |
| Air flow (measuring stations) | ±5% of reading |
| Air pressure (ducts) | ±25 Pa |
| Air pressure (space) | ±3 Pa |
| Water pressure | ±2% of full scale (Note 2) |
| Electrical power (A, V, W, Power Factor) | ±1% of reading (Note 3) |
| Carbon monoxide (CO) | ±50 PPM |
| Carbon dioxide (CO2) | ±50 PPM |

1). Note 1: (5%-100% of scale) (cannot read accurately below 5%)
2). Note 2: for both absolute and differential pressure
3). Note 3: not including utility supplied meters.

10. In general, all non-critical temperature/humidity areas shall be designed to maintain the following conditions in accordance with the current International Energy Conservation Code:
    a). Summer periods: minimum 75F +/- 2ºF"; 50% RH +/- 10% RH in occupied areas.
    b). Winter periods: maximum 72F +/- 2ºF"; 30% RH +/- 10%RH in occupied areas.
    c). The summer period requirements listed above shall be maintained with an outdoor air-dry bulb temperature of 105° F concurrent with a wet bulb temperature of 70° F.
    d). The winter period requirements listed above shall be maintained with an outdoor dry bulb temperature of 20° F.

1.15. OWNERSHIP OF PROPRIETARY MATERIAL

A. All project developed hardware and software shall become the property of the Owner. These include but are not limited to:

B. Project graphic images,

C. Record drawings,

D. Project database,

E. Job-specific application programming code,

F. All documentation.

PART 2 PRODUCTS

2.1. APPROVED CONTROL SYSTEM CONTRACTOR for SASSLC:

A. Company Name

1. Automated Logic
2. Substitutions: Section 01 60 00 and 22 05 00 Mechanical General Requirements: – Product Requirements.

2.2. OPERATOR INTERFACE

A. Operator Interface. Utilize the existing PC based work-stations as shown on the system drawings. Each of these work-stations shall be able to access all information in the system. These work-stations shall reside on the same high-speed network as the building controllers, and also be able to dial into the system.

B. Work-station information access shall use the BACnet Protocol. Communication shall use the ISO 8802-3 (Ethernet) or ARCNET (ASTM 878.1) Physical/Data Link layer protocol. Remote communications shall use the BACnet Point to Point Physical/Data Link Layer Protocol.

1. SASSLC approved interface drivers and protocols are:
   a). Within the building (2-4 wire interfaces): BACnet only.
   b). On the Campus level Ethernet – BACnet/IP

C. System Software:

1. Operating System. Furnish a commercially available, concurrent multi-tasking operating system. The operating system shall also support the use of other common software applications that operate Microsoft Windows. Accessible systems include Microsoft Windows 10, Windows Server 2008 or 2012, Red Hat Enterprise Linux, or Ubuntu Desktop 12.04.
2. Security. The web server application shall support Transport Layer Security (TLS) with a capability of 256-bit encryption for transmitting private information over the Internet using HTTPS. Additionally, the web server shall have SHA-2 certificate support.
3. Database. System shall support any JDBC (Java Database Connectivity) compliant engine. This includes: MS SQL, My SQL, PostgreSQL, and Oracle
4. System Graphics. The Operator Work-station software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for

comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.

a). Custom Graphics. Custom graphic files shall be created with the use of commonly available graphics packages such as PC Paint. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as PCX, BMP, GIF and JPEG. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.

b). Color Graphics—Follow SASSLC Convention

1). The graphics shall be able to display and provide animation based on real-time data that is acquired, calculated, or entered.

2). Multiple graphic applications shall be able to execute at any one time on a single workstation.

3). All graphics shall be constructed from basic graphical objects.

4). Shall be capable of being animated.

5). It shall be possible to change values (set-points) and states in system-controlled equipment from the color graphics screen.

6). Color Code.

(a). One of seven colors shall be generated to represent the comfort conditions in the space and shall be displayed graphically at the operator station.

(b). If the actual space temperature is in the dead band between the heating setpoint and the cooling setpoint, the color displayed shall be green for the occupied mode, representing ideal comfort conditions. If in the unoccupied mode, the color displayed shall be gray representing 'after-hours' conditions.

(c). If the space temperature rises above the cooling setpoint, the color shall change to yellow. Upon further rise beyond the cooling setpoint plus an offset, the color shall change to orange. Upon further rise beyond the cooling setpoint plus the yellow band offset, plus the orange band offset, the color shall change to red indicating unacceptable high temperature conditions. At this point an alarm shall be generated to notify the operator.

(d). When space temperature falls below the heating setpoint, the color shall change to light blue. Upon further temperature decrease below the heating setpoint minus an offset, the color shall change to dark blue. Upon further space temperature decrease below the heating setpoint minus the light blue band offset minus the dark blue band offset the color shall change to red indicating unacceptable low temperature conditions. At this point an alarm shall be generated to

e). A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing all drawing functions, defining all calculations to be executed as part of the graphic, defining all animations, and defining all runtime binding. It is not acceptable for separate programs to be required to do these various functions.

f). The EMCS system shall be provided with a complete symbol library containing all of the basic symbols used to represent HVAC and Power Monitoring components of a typical EMCS system

g). Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and duct-work. The library shall be furnished in a file format compatible with the graphics generation package program.

h). All device names (acronyms) shall follow SASSLC standard naming conventions

i). Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be: Standard Inch Pound.

E. System Applications. Each work-station shall provide operator interface and off-line storage of system information. Provide the following applications at each work-station.

1. Automatic System Database Save and Restore. Each work-station shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first work-station to detect the loss shall automatically restore the database for that panel.
2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
3. System Configuration. The work-station software shall provide a graphical method of configuring the system. The user with proper security shall be able to assign modems to devices. This shall allow for future system changes or additions.

4. On-Line Help. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
6. System Diagnostics. The system shall automatically monitor the operation of all work-stations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
   a). Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by work-station and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.
   b). Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
   c). Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.
11. Trend Logs. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.

12. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the work-station.
13. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.
14. Clock Synchronization. The real time clocks in all building control panels and work-stations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.
15. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals.
    a). Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
    b). Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.
        1). Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.
        2). Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12 month) report that shows the monthly consumption for each meter.
        3). Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.
        4). Tenant Override Reports: Provide a monthly report showing the daily total time in hours that each tenant has requested after hours

HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.

5). ASHRAE Guideline 3-1996 Report: Provide a daily report that shows the operating condition of each chiller as required by ASHRAE Guideline 3. At minimum this report shall include:

(a). Chilled Water (or other fluid) inlet and outlet temperature
(b). Chilled Water (or other fluid) flow
(c). Chilled Water (or other fluid) inlet and outlet pressures
(d). Condenser water inlet and outlet temperatures
(e). Condenser water flow
(f). Refrigerant levels
(g). Oil pressure and temperature
(h). Oil level (if applicable)
(i). Compressor refrigerant discharge temperature
(j). Compressor refrigerant suction temperature
(k). Manual entry field for addition of refrigerant
(l). Manual entry field for addition of oil
(m). Manual entry field for Vibration levels
(n). Motor amperes per phase
(o). Motor volts per phase
(p). PPM refrigerant monitor levels
(q). Purge exhaust time or discharge count
(r). Ambient temperatures (dry bulb and wet bulb)
(s). Date and time data logged

F. Work-station Applications Editors. Each PC work-station shall support full screen editing of all system applications. Provide editors for each application at the PC work-station. The applications shall be downloaded and executed at the appropriate controller panels.

1. Controller. Provide a full screen editor for each type controller and application that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.
2. Scheduling. An editor for the scheduling application shall be provided at each work-station. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
   a). An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
3. Equipment Coordination. Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV boxes with their associated Air Handling Equipment.
4. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create,

edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:

a). The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provides the functions listed below, and that custom or compound function blocks can be created.

b). A full screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.

c). The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.

d). The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.

e). The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

f). The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.

g). The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.

h). The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of BACnet objects in the system.

## 2.3. SYSTEM SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator work-station.

B. System Security:

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
3. User logon/logoff attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1. Weekly Schedule. Provide separate schedules for each day of the week.
2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
4. Optimal Start/Stop. The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

D. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate work-stations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.

1. Software alarms shall be provided for analog deviation, run-time, utility services failure, space comfort range deviation, and additional alarms as directed by SASSLC.
2. Alarms shall report device location, software name, description, and criticality of alarm. Alarms shall report to the designated Work Stations and be logged on the alarm printer showing date and time of alarm

E. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, to minimize network traffic, and to prevent alarms from being lost. At no time shall the DDC panel's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network.

1. Point Change Report Description
   a). All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.
2. Prioritization
   a). The installer shall set up all system analog points with high and low alarm limits. All digital system points shall be associated with a status feedback point and all exceptions shall be reported as alarms.
   b). The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized and filtered to minimize nuisance reporting and to speed operator response to critical alarms.
   c). The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.
   d). The controls system will maintain an audit trail of operator activity. This will include but not be limited to - log in, log out, overrides, set point changes, schedule changes, system changes, downloads, uploads, and alarm activity.
3. Critical and Non-Critical Alarm Routing
   a). Critical alarms shall be displayed at the designated workstations, printed at the alarm printer, and paged to the on-duty maintenance person over the owner's or vendor's paging system, as requested by the owner. Alpha pages shall provide sufficient information to identify the equipment and the point in alarm and the time and date of occurrence.
   b). All other alarms shall be considered non-critical and shall be displayed and acknowledged before being sent to the alarm log.
4. Alarm Messages
   a). In addition to the point's descriptor and the time and date, the user shall be able to print, display, or store an alarm message to more fully describe the alarm condition or direct operator response.
   b). Each standalone DDC panel shall be capable of storing an alarm message for each point.
5. Auto-Dial Alarm Management
   a). Dial-up systems are unacceptable

F. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations, and Alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to

remotely access and operate the system using dial up communications in the same format and method used on site under section 2.1 (Operator Interface).

G. Demand Limiting:

1. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.
2. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
3. Control system shall be capable of demand limiting by resetting HVAC system set-points to reduce load while maintaining Indoor Air Quality (humidity, VOC, CO2) and comfort control in the space.
4. Input capability shall also be provided for an end-of-billing period indication.

H. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.

I. Boiler Sequencing: Provide applications software to properly sequence the chiller plant to minimize energy use. This application shall perform the following functions:

1. The boiler plant control application shall have the ability to control a maximum of 25 boiler of any type including centrifugal, helirotor, scroll, and reciprocating and absorption machines as detailed in the sequence of operations.
2. This application shall be able to control both constant and variable flow systems as well as parallel, series and decoupled piping configurations.
3. The chiller plant control application shall be able to control multiple chiller plants per site.
4. Diagnostics/Protection - the chiller plant application program shall be able to integrate individual chiller diagnostics into control action decisions.
5. Event Processing - All chiller plant control and status events shall be recorded, at the operator's selection, in the building management system event log to facilitate troubleshooting.
6. Alarm Indications - The chiller plant control status screens shall display chiller plant and individual chiller alarm messages.

J. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.

K. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user-selectable.

L. System Calculations. Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. GPM) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.

M. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

## 2.4. CONTROL UNITS

A. General: Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements:

1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.
2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
3. The controller shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the inter-network.
4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
5. Controllers that perform scheduling shall have a real time clock.
6. Data shall be shared between networked Building Controllers.
7. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
   a). Assume a predetermined failure mode.
8. Remote DDC units shall accommodate all points specified by the Engineer.
9. The DDCs shall be located near the highest concentration of field points. The location shall be approved by SASSLC Facilities Systems Engineering Department.
10. The DDC controller shall be enclosed in a cabinet. The cabinet shall be constructed such that it can be mounted, and electrical terminations made during the installation phase of the project, without the control electronics being installed. The cabinet shall be NEMA rated for its location and expected environment. The DDC electronics shall be modular and shall be added during the commissioning phase of the project. The DDC cabinet and any associated

units, for example Field Equipment Units (FEUs) shall be provided with a master keyed lock, keys turned over to SASSLC Physical Plant.

11. The EMCS shall also be expandable by adding additional field interface units that operate through the processor in the DDC Controller. The processor in the DDC shall be able to manage remote field interface units, expanding its control loop and energy management point capacity.
12. The DDCs shall be stand alone, with CPU's, clock, and communication interfaces.
13. The DDCs shall contain point modules, interface modules, etc. for the connected field equipment and third-party controllers.
14. Control, communication and power circuits shall be individually electronically isolated to protect against transients, spikes, and power surges.
15. The DDC shall be an approved UL system, with a UL listing as a Signaling System

B. Generate an alarm notification:

1. BACnet: The Building Controller shall use the Read (Initiate) and write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standards 135-95, to communication with BACnet objects in the inter-network. Objects supported shall include: Analog input, analog output, binary input, binary output, and device.
2. Communications: Each Building Controller shall reside on a BACnet inter-network using the ISO 8802-3 (Ethernet) or ARCNET (ASTM 878.1) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.
3. Environment: Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure and shall be rated for operation at 0 degrees C to 50 degrees C (32 F to 120 F).
4. Serviceability: Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory: The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
6. Immunity to power and noise Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

## 2.5. INPUT/OUTPUT INTERFACE

A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.

B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and

output points shall be protected from voltage up to 24V of any duration, such that the contact with this voltage cause no damage to the controller.

C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.

D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation and shall be protected against effects of contact bounce and noise.

E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20ma), or resistance signals (thermistor, RTD). Analog units shall be compatible with, and field configurable to commonly available sensing devices.

F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on custom and building controllers shall have 3-postion (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the support device. Analog outputs on building or custom programmable controllers shall have status lights and a 2-pocition (auto/manual) switch and manually adjustable potentiometer for manual override.

## 2.6. AUXILIARY CONTROL DEVICES

A. Electronic valve actuators:

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of either clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
9. Actuators shall be Underwriters Laboratories Standard 873 listed.
10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
11. Acceptable manufacturers: Johnson Controls, Belimo, Honeywell. Other models must be approved by Plant Engineering.

B. Control Valves:

1. Control valves shall be two-way or three-way type for two positions or modulating service as scheduled or shown.
2. Close-off (differential Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure rating:
   a). Water Valves: Two-way 150% of total system (pump) head. Three-way 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
3. Water Valves:
   a). Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating services.
   b). Sizing Criteria:
      1). Two-position: line size
      2). Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi whichever is greater.
      3). Three-way modulating Service: Pressure drop equal to twice the pressure drop though the coil exchanger (load), 5 psi maximum.
      4). Valves ½" through 3" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two position service. Two-way valves to have replaceable composition disc, or stainless-steel ball. Control valves 2-1/2" and smaller ball valves. Valves shall be provided with spring return electric actuation, positive position feedback and manual override.
      5). 3" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing. Valves shall be provided with spring return electric actuation, positive position feedback and manual override
   c). Water valves shall fail normally open or closed as scheduled on plans or as follows:
      1). Heating coils in air handlers – normally open.
      2). Chilled water control valves – normally closed.

3). Other applications – as scheduled or as required by sequence of operation.

d). Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

e). Acceptable manufacturers: Belimo, Honeywell, Johnson Controls, Warren. Other models must be approved by SASSLC Systems Engineering.

C. Temperature sensors:

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed,
3. Provide Matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C (0.2 F).

D. Well Insertion Temperature Sensors

1. When thermowells are required, the sensor and well shall be supplied as a complete assembly, including well head and Greenfield fitting.
2. Thermowells shall be stainless steel pressure rated and constructed in accordance with the system working pressure. Brass thermal wells are unacceptable.
3. Thermowells and sensors shall be mounted in a threadolet or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement. (5) Thermowells shall be constructed of 316 stainless steel.
4. Acceptable Manufacturers: Johnson Controls TE, ACI, BAPI ,Hycal or Prior Approved Equal.

E. Low limit thermostats:

1. Safety low limit thermostats shall be vapor pressure type with an element 6m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

F. Current Sensing Switches

1. The current sensing switch shall be self-powered with solid state circuitry and a dry contact output.
2. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
3. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

4. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

G. Flow Switches:

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water services only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 type enclosure unless otherwise specified.
3. Differential pressure type switches (air and water service) shall be UL listed SPDT snap-acting, pilot duty rated (125 VA minimum) NEMA 1 type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.
5. Acceptable manufacturers: Johnson Controls, Cleveland Controls or Prior Approved Equal.

H. Relays:

1. Control relays shall be UL listed plug0in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Output relays for start/stop control shall be plug in type, DPDT or 3PDT 10A rated. Relays shall be mounted at or within the motor starters, or in the Field Panels
3. Time delay shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 type enclosure when not installed in local control panel.

I. Transformers and power supplies:

1. Control transfer shall be UL listed Class 2 current limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load change. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.

J. Current switches:

1. Current-operate switches shall be self-powered solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

K. Local Control panels:

1. All indoor control cabinets shall be fully enclosed NEMA 1 type construction with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.
2. Interconnections between internal and face-mounted devices pre-wired with color-code strand conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control identified per control drawings.
3. Provide on/off power switch with over-current protection and main air gauge for control power sources to each local panel.

## 2.7. WIRING AND RACEWAYS

A. Wiring refer to 26 05 19 Building Wire and Cable for further information.

B. Raceways refer to Sections 26 05 33 Conduit and 26 05 36 Cable Trays for further information.

# PART 3 EXECUTION

## 3.1. EXAMINATION

A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.

B. Verify that conditioned power supply is available to the control units and to the operator workstation. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

C. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

D. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reports to the Architect/Engineer for resolution before rough-in is started.

E. Prior to software generation, the EMCS contractor shall submit the following information for review to SASSLC:

1. Complete set of approved submittals.

2. “Tree” outline of color graphics for the front-end Operator's Work Station (OWS).
3. Samples of Trends and History standard reports on the front end OWS.
4. List of alarm points, their limits, classification of alarms, associated alarm messages interlocks with devices to inhibit alarms, and other relevant alarm reporting features.
5. Initial setpoint values for controlled variables and schedules.
6. List of advisories for operators for manual control.

## 3.2. INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.

C. Provide with 120v AC, 15 amp dedicated power circuit to each programmable control unit. Coordinate electrical outlet requirements with Electrical and Mechanical Contractors.

D. Electrical Contractor is to provide and install conduit and electrical wiring in accordance with Section 26 05 19 and 28 05 33. Electrical material and installation shall be in accordance with appropriate requirements of Division 16.

E. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical and parallel to walls) wherever possible.

F. Provide sufficient slack and flexible connections to allow for vibrations of piping and equipment.

G. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow foe unobstructed access for service.

H. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

I. All equipment, installation and wiring shall comply with acceptable industry specifications and standards for performance, reliability and compatibility and be executed in strict adherence to local codes and standard practices.

## 3.3. INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer’s recommendations.

B. Mount sensors rigidly and adequate for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their conduits.

E. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.

F. Wiring far space sensors shall be concealed in building walls in conduit only EMT conduit is acceptable within mechanical and service rooms.

G. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.4. FLOW SWITCHES INSTALLATION

A. Install using a tread-o-let in steel pie. In copper pipe use C x C x F tee, no pipe extensions or substitutions allowed.

B. Mount minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 2 feet whichever is greater, form fittings and other obstructions.

C. Install in accordance with manufacturer's instructions.

D. Assure correct flow direction and alignment.

E. Mount in horizontal piping – flow switch on top of the pipe.

3.5. ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

B. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close damper and then tighten the linkage.

C. Check operation of damper/actuators combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

D. Valves – Actuators shall be mounted on valves with adapters approved by the actuators manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.6. WARNING LABELS

A. Affix plastic labels on each starter and equipment automatically controlled through the Control System. Label shall indicate the following:

| **C A U T I O N** |
| --- |
| This equipment is operating under automatic control and may start at any time without warning. |

## 3.7. IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels shall be labels at each end within 2” of termination with a cable identifier and other descriptive information.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1/4” inch letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labels such that removal of the equipment does not remove the label.

E. Refer to Section 23 05 53 Mechanical Identification for further information.

## 3.8. CONTROLLERS

A. Provide a separate controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from these requirements.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.

C. Future use of spare capacity shall require providing the field device, field, wiring, point database definition, and custom software. No addition Controller boards or point modules shall be required to implement use of these spare parts.

## 3.9. PROGRAMMING

A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming: provide programming for the system as per specifications and adhere to the strategy algorithms provided, all other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. Operators' Interface:

1. Standard Graphics: Provide graphics for each major piece of equipment and floor plan in the building. This includes each chiller, air handler, VAV terminal, fan coil, boiler, and cooling tower. These standard graphics shall show all points dynamically as specified in the points list.

2. The control contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.

3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection and permits acceptance of the delivered system for on-line operation.

## 3.10. CLEANING

A. This contractor shall clean all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and place in a location designated by the Construction Manager or General Contractor.

B. At the completion of work in any are, the Contractor shall clean all of his/her work, equipment, etc. making it free from dust dirt and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked of paint damage, and any factory finished paint that has been damaged

shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

## 3.11. PROTECTION

A. The contractor shall protect all work and materials from damage by his/her work or workers and shall be liable for all damage thus caused.

B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect his/her work against theft or damage and shall carefully store material and equipment received on site that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

## 3.12. ACCEPTANCE

A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction or both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements of states as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

## 3.13. INSTRUCTIONS TO OTHER CONTRACTORS

A. Control Valve Installation:

1. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
2. All control valves shall be installed so that the stem position is not more than 60-degree from the vertical up position.
3. Valves shall be installed in accordance with the manufacturer's recommendations.
4. Control valves shall be installed so that they are accessible and serviceable and such that actuators may be services and removed without interference from structure or other pipes and/or equipment.
5. Isolation valves shall be installed such that control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screwed type control valves.
6. Provide tags for all control valves indicating service and number. Tags shall be brass, 1-1/2" in diameter, with 1/4" high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

B. Control Damper Installation

1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4” larger than damper dimensions and shall be square straight, and level.
3. Individual damper section, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal ± 1/8”
4. Follow manufacturer’s instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
5. Install extended shaft or jackshaft per manufacturer’s instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
6. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
7. Provide a visible and accessible indication of damper position on the drive shaft end.
8. Support duct-work in area of damper when required to prevent sagging due to damper weight.
9. After installation of low-voltage dampers with seals, caulk between frame and duct ort opening to prevent leakage around perimeter of damper.

C. Duct Smoke Detection:

1. Provide complete submittal data to controls system contractor for coordination of duct smoke detector interface to HVAC system.
2. This contractor shall provide a dry-contract alarm output on the same room as the HVAC equipment to be controlled.

## 3.14. MANUFACTURER'S FIELD SERVICES

A. Section 01 45 00 – Quality Requirements: Manufacturers’ field services.

B. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

C. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3-day period.

## 3.15. DEMONSTRATION AND TRAINING

A. Provide basic operator training for 10 persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 40 hours instructor time. Provide training on site. The training shall focus on general design, operation, and maintenance procedures of the products installed, and shall cover: The training shall include at a minimum the following:

1. communication and point wiring, and location and installation of all sensors and control devices.
2. Operation of person-machine interface including logging on/off, interrogating the system, producing reports, acknowledging alarms, overriding computer control, and changing firmware/software parameters.
3. Programming the EMCS using the editor and the design of custom control software.
4. Overview of system configuration/architecture, equipment controlled/monitored, system device locations, sequence of operation, control software structure and
5. Hardware maintenance, calibration, troubleshooting, diagnostics, and repair instructions.
6. Controls contractor shall submit to the District, 15 days in advance for District approval, a written Agenda listing the subjects to be covered and the time frame for each subject. The first session shall be provided at the completion of the project. Additional sessions shall be provided after six months and again after one year at the request of the Owner.

B. Demonstrate complete and operating system to Owner.

C. Submit Training course outlines prior to class for review to the Owner.

3.16. SCHEDULES AND POINTS LIST – SEE DRAWINGS

END OF SECTION 23 09 23

# SECTION 23 21 13 – HYDRONIC PIPING

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Pipe and pipe fittings for:

1. Heating water piping system.
2. Chilled water piping system.
3. Condenser water piping system.

B. Valves:

1. Ball valves.
2. Plug valves.
3. Butterfly valves.
4. Check valves.

### 1.2. RELATED SECTIONS

A. Section 23 05 53 - Mechanical Identification.

B. Section 22 07 19 - Piping Insulation.

C. Section 23 21 16 - Hydronic Specialties.

D. Section 26 05 03 – Equipment Wiring Systems: Electrical characteristics and wiring connections.

### 1.3. REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 – Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.

C. ASME B31.9 - Building Services Piping.

D. ASTM F 2389-07 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

E. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications

F. NSF/ANSI 14 – Plastic Piping System Components and Related Materials

G. ASTM F708 – Design and Installation of Rigid Pipe Hangers.

H. AWS D1.1 - Structural Welding Code.

I. MSS SP58 – Pipe Hangers and Supports – Materials, Design and Manufacture.

J. MSS SP69 – Pipe Hangers and Supports – Selection and Application.

K. MSS SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices.

1.4. SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, insures system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing is consistently provided.

B. Use grooved mechanical couplings and fasteners in accessible locations.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

E. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.

F. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

G. Use ball or butterfly valves for throttling, bypass, or manual flow control services.

H. Use spring loaded check valves on discharge of condenser water pumps.

I. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

J. Use butterfly valves in heating water systems, in chilled and condenser water systems.

K. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

L. Use lug end butterfly valves to isolate equipment.

M. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.5. SUBMITTALS

A. Submit under provisions of Section 01 30 00 and 22 05 00 – Mechanical General Requirements.

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.6. PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 70 00 and 22 05 00 – Mechanical General Requirements.

B. Record actual locations of valves.

1.7. OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 70 00 and 22 05 00 – Mechanical General Requirements.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by the manufacturer.

1.9. REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 and 22 05 00 – Mechanical General Requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11. ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.12. EXTRA MATERIALS

A. Furnish under provisions of Section 01 70 00 and 22 05 00 – Mechanical General Requirements.

B. Provide two repacking kits for each size and valve type.

PART 2 – PRODUCTS

2.1. CONDENSOR WATER, CHILLED WATER AND HEATING WATER PIPING

A. Aquatherm.

1. PIPE AND PIPING PRODUCTS
   a. Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from

resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Hydronic hot water and heating piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall be manufactured with a 1 mm (0.039”) layer of HDPE to protect the pipe from UV exposure. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

b. Cold Pipe shall be Aquatherm Blue Pipe® SDR 7.4/11 MF.

2. FITTINGS

a. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

b. Fittings shall be Aquatherm® Green Pipe® or Blue Pipe® available from Aquatherm, NA. Fittings specifications and ordering information are available at www.aquatherm.com. Note that the fittings do not need to have UV protection.

c. Fittings shall be installed according to the manufacturer’s instructions.

3. SMOKE AND FIRE RATINGS

a. Where indicated on the drawings that a Plenum-rated Piping System is needed, then the pipe shall be wrapped and/or insulated with standard pipe insulation, field installed. The pipe wrap or insulation shall meet the requirements of CAN/ULC-S102.2-03 or ASTM E84. The system shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

4. UV PROTECTION

a. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.

5. THERMAL AND VAPOR BARRIER

a. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of American Society of Heating, Refrigeration, and Air Conditioning Engineers ASHRAE 90.1 (current edition), "Energy Efficient Design of New Buildings." However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

b. Where standard pipe insulation is indicated on the drawings or in these

specifications, the contractor shall provide a thermal (radiant, conductive, and convective) and vapor barrier insulation. The insulation products shall be as indicated on the drawings or elsewhere in these specifications. The standard pipe insulation shall be UV resistant, CFC-free, non-porous, non-fibrous, and resist mold growth.

## 2.2. PIPE HANGERS AND SUPPORTS

A. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, AND MSS SP89.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron or Carbon steel, adjustable swivel, split ring.

C. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

D. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

H. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

I. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

J. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

K. Vertical Support: Steel riser clamp.

L. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

M. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

N. Inserts: Malleable iron case of [galvanized] steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3. UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.4. BALL VALVES

A. Up To and Including 2 Inches:

1. Manufacturers:
   a) NIBCO.
   b) Kitz
   c) Milwaukee.
   d) Grinnell Corp.
   e) Red-White Valve Corp.
   f) Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

2. Bronze two piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends with union.

B. Over 2 Inches:

1. Manufacturers:
   a) NIBCO.
   b) Kitz
   c) Milwaukee.
   d) Grinnell Corp.
   e) Red-White Valve Corp.
   f) Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

2. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.5. BUTTERFLY VALVES

A. Manufacturers:

1. NIBCO.
2. Kitz
3. Milwaukee.
4. Grinnell Corp.
5. Red-White Valve Corp.
6. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

C. Disc: Chrome plated ductile iron or stainless steel.

D. Operator: 10 position lever handle] [Infinite position lever handle with memory stop.

2.6. SWING CHECK VALVES

A. Up To and Including 2 Inches:

1. Manufacturers:
   a) NIBCO.
   b) Kitz
   c) Milwaukee.
   d) Grinnell Corp.
   e) Red-White Valve Corp.
   f) Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

2. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

B. Over 2 Inches:

1. Manufacturers:
   a) NIBCO.
   b) Kitz

c) Milwaukee.
d) Grinnell Corp.
e) Red-White Valve Corp.
f) Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

2. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.7. SPRING LOADED CHECK VALVES

A. Manufacturers:

1. NIBCO.
2. Kitz
3. Milwaukee.
4. Grinnell Corp.
5. Red-White Valve Corp.
6. Refer to Sections 22 05 13 – Basic Mechanical Material and Methods and 22 05 00 – General Mechanical Requirements: For Product options and substitutions.

B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

PART 3 – EXECUTION

3.1. PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, [chilled water,] condenser water, and engine exhaust piping to ASME B31.9. [Install chilled water piping to ASME B31.5.]

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 22 16.

I. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut [above] [flush with top of] [recessed into and grouted flush with] slab.

J. Pipe Hangers and Supports:

1. Install in accordance with ASTM B31.9, ASTM F708, and MSS SP89.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

L. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

N. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.

O. Install valves with stems upright or horizontal, not inverted.

P. SCHEDULES

1. Pipe Hanger Spacing.

| HANGER ROD | | |
|---|---|---|
| PIPE SIZE | MAX. HANGER SPACING | DIAMETER |
| Inches | Feet | Inches |
| 1/2 to 1-1/4 | 6.5 | 3/8 |
| 1-1/2 to 2 | 6.5 | 3/8 |
| 2-1/2 to 3 | 10.0 | 1/2 |
| 4 to 6 | 10.0 | 5/8 |
| 8 to 12 | 14.0 | 7/8 |

END OF SECTION 23 21 13

# SECTION 23 21 23 – HVAC PUMPS

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Base mounted pumps.

### 1.2. RELATED SECTIONS

A. Section 23 05 13 - Motors.

B. Section 23 07 19 – Hydronic Piping Insulation.

C. Section 23 21 13 - Hydronic Piping.

D. Section 23 06 20 - Hydronic Specialties.

E. Section 26 05 63 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

### 1.3. REFERENCES

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

### 1.4. PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

### 1.5. SUBMITTALS

A. Submit under provisions of Section 01 30 00 and 22 05 00.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve and impeller size. Include electrical characteristics and connection requirements. Submit data indicating dimensions, rough-in connections, and electrical characteristics and connection requirements. Submit capacity and dimensions of manufactured products and assemblies required for this Project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections. Submit data for manufactured products and assemblies. Indicate water, drain valves, service maintenance and access clearances, indoor or outdoor rated, and

electrical rough-in connections with electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Millwright's Certificate: Certify that base mounted pumps have been aligned.

1.6. OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 70 00 and 22 05 00.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three documented years experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright.

1.8. REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by [UL] [testing firm acceptable to the authority having jurisdiction] as suitable for the purpose specified and indicated.

1.9. EXTRA MATERIALS

A. Furnish under provisions of Section 01 70 00 and 22 05 00.

B. Provide one set of mechanical seals for each pumps.

C. Provide spare pumps as noted ion the drawings

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. Bell & Gossett (B&G)].

B. TACO.

C. PACO.

D. Armstrong.

E. Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.

2.2. BASE MOUNTED PUMPS

A. Type: Horizontal shaft, single stage, direct connected, radially split casing, for 125 psig maximum working pressure.

B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft. Factory trim the impeller to match the specified flow

D. Bearings: Grease lubricated roller or ball bearings with Zirk fittings.

E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

F. Seal: Carbon rotating against a stationary ceramic seat, viton fitted, 275 degrees F maximum continuous operating temperature.

G. Drive: Flexible coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

I. Pumps shall be outdoor rated for installation in outdoor environment.

J. Performance: Refer to pump schedule on drawings for information.

K. Electrical Characteristics: Refer to pump schedule on drawings for information.
   1. Motor: 1750 rpm unless specified otherwise; refer to Section 23 05 13.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
   3. Electrical shall be NEMA 3R rated for outdoor installation.
   4. Provide magnetic starter with HOA switch for all three (3) phase pumps and rated for horsepower specified and NEMA1 or NEMA 3R as required.

PART 3 EXECUTION

3.1. PREPARATION

A. Verify that electric power is available and of the correct characteristics.

## 3.2. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer. Install equipment with and maintain all service clearances as required or recommended by the manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

D. Provide line sized shut-off valve and strainer, pump suction fitting on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

E. Provide drains for bases and seals, piped to and discharging into floor drains.

F. Check, align, and certify alignment of base mounted pumps prior to start-up.

G. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 30 00.

H. Lubricate pumps before start-up.

I. Coordinate installation of disconnect VFD and magnetic starter with the Electrical Contractor.

J. SCHEDULES: Refer to pump schedule on drawings for information.

END OF SECTION 23 21 23

# SECTION 23 52 34 HEATING WATER BOILERS

## PART 1 – GENERAL

### 1.1. SUMMARY

A. The work to be performed includes all new equipment, labor and materials required to furnish and install ultra-high efficiency Condensing Hydronic Boilers as described in this product guide specification.

### 1.2. RELATED SECTIONS

A. Section 23 21 13 – Hydronic Piping.

B. Section 23 51 00 – Breeching, Chimneys, and Stacks (Venting).

C. Section 23 09 23 – Direct Digital Control.

### 1.3. REFERENCES

A. ANSI Z21.13/CSA 4.9

B. ASME, Section IV

C. 2006 UMC, Section 1107.6

D. ANSI/ASHRAE 15-1994, Section 8.13.6

E. National Fuel Gas Code, NFPA 54/ANSI Z223,1

### 1.4. SUBMITTALS

A. Product data sheet (including dimensions, rated capacities, shipping weights, accessories).

B. Wiring diagram

C. Warranty information

D. Installation and operating instructions

### 1.5. QUALITY ASSURANCE

A. Regulatory Requirements ANSIZ21, 13/CSA4.9 – Local and national air

quality regulations for low NOx (0-20 PPM NOx emissions) boilers.

B. Certifications – CSA and ASME H Stamp and National Board Listed.

1.6. WARRANTY

A. Limited one-year warranty from date of installation

B. Limited twenty-year thermal shock warranty

C. Limited ten-year closed-system heat exchanger warranty

PART 2 – PRODUCTS

2.1. MANUFACTURER

A. Fulton

B. Lochinvar,

C. RBI

D. Raypak, Inc.

E. Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.

2.2. BOILER CONSTRUCTION

A. The boiler shall be completely factory assembled as a self-contained unit. Each boiler shall be neatly finished, thoroughly tested, and properly packaged for shipping.

B. The pressure vessel design and construction shall be in accordance with Section IV of the ASME Code for heating boilers. The boiler shall comply with CSD-1 code requirements.

C. The firetube area of the heat exchanger where the flue gases will condense shall be constructed using duplex alloys of stainless steel. Austenitic stainless steels of the 300 series, such as 316L or 304, have a relatively high coefficient of linear expansion and thus are unacceptable. Ferritic stainless steels of the 400 series, such as 439, have a relatively low ultimate tensile strength and a relatively low pitting resistance equivalent number and thus are unacceptable.

D. The pressure vessel shell and furnace chamber shall be a minimum 3/8” thick steel, SA-53B ERW pipe or SA-516 Grade 70 plate. A dished head attached to

the furnace chamber shall be SA-516 Grade 70 plate. Exhaust pipes attached to the furnace chamber shall be minimum 3” diameter Schedule 40 steel.

E. Boilers with heat exchangers using cast aluminum, cast iron or copper finned tube design platforms are unacceptable.

F. The pressure vessel shall be fully insulated with high temperature insulation.

G. The boiler shall be a fire tube design. The furnace location shall be such that all furnace components are within water-backed areas.

2.3. BOILER DESIGN

A. External convection and radiation heat losses to the boiler room from the boiler shall be less than 0.5% of the rated boiler input.

B. The boiler shall have its efficiency witnessed and certified by an independent third party, and the efficiency must be listed on the AHRI directory (www.ahridirectory.org) for natural gas operation. The test parameters for efficiency certification shall be the BTS-2000 standard, with 80˚F return water temperature, 180˚F supply water temperature, steady state operation at full input firing capacity. The certified thermal efficiency for natural gas firing shall not be less than:
   1. VTG-3000 - 96.3%
   2. VTG-4000 - 96.9%

C. The boiler shall have no minimum return water temperature requirements.

D. The boiler shall have an optional configuration for dual fuel with natural gas/propane.

E. The boiler shall have an optional configuration for NEMA 3R construction (outdoor operation).

F. The boiler shall have an optional configuration for digester gases and bio gases. Factory engineers must have the opportunity to review and approve these applications in advance.

G. The boiler shall have no minimum return water temperature when firing on natural gas or propane.

H. A zero flow or low flow condition shall not cause any harm to the pressure vessel or heat exchanger of the boiler. Flow switches, dedicated circulator pumps, or primary/secondary piping arrangements are not required to protect the heat exchanger or pressure vessel from thermal shock or other system

related considerations. Boilers requiring the use of flow switches or primary/secondary piping arrangements are unacceptable.

I. It shall be acceptable to install any number of Vantage boilers except the VTG-5000 boilers with as little as 1” side clearance on either side of the boiler.

J. It shall be acceptable to vent the boiler using sealed combustion (drawing in fresh air from the outdoors) or to draw air from the mechanical room itself.
   1. The flue (exhaust) stack must be AL 29-4C or equivalent material UL-1738/C-UL S636 approved for Category IV condensing, positive pressure applications.
   2. The air intake piping must be Schedule 40 PVC or equivalent.
   3. The boiler shall be capable of operating with an exhaust draft not exceeding -0.04” W.C. and a combined air intake and exhaust venting pressure drop not exceeding +0.35” W.C.

K. Boilers requiring an intake or exhaust muffler for noise sensitive applications are unacceptable.

## 2.4. CONTROLS

A. The boiler control panel shall be constructed in a UL 508A approved panel shop.

B. The flame safeguard control shall be capable of linkage-less modulation and shall provide the following:
   1. The control shall provide a 30-second pre-purge and post-purge time.
   2. The control shall maintain a running history of operating hours, number of cycles, and the most recent six control lockouts.
   3. The control is connected to a display module, which is capable of retrieving the information listed above.

C. The boiler shall be set up for a maximum 5:1 turndown when firing on natural gas. Any boiler claiming turndown greater than 5:1 must provide references for five (5) installations of similar capacity operating at the claimed turndown for at least (3) complete heating seasons.

D. Airflow shall be controlled by a butterfly valve connected to a precision servo-motor. Fuel flow shall be controlled by a butterfly valve for gas operation.

E. Burner selection:
   1. The burner shall be a Maxon Ovenpak model nozzle mixing style burner. The burner shall be of industrial grade cast iron design and designed to

operate reliably over a variety of operating conditions, including extreme variations of combustion air temperature and pressure.

F. The burner gas ignition system for the main gas shall utilize natural gas or as the fuel source. The gas pilot system components shall include spark ignited pilot assembly, 7000 Volt ignition transformer, pilot safety shut off valve, pilot gas pressure regulator and manual gas shutoff cock. The burner oil ignition system shall be by means of a separate 2 x 5000 Volt direct spark ignition system.

G. The burner shall be equipped with a single pole double throw air pressure switch that will not allow burner to start if there is insufficient combustion air, which is checked prior to each ignition attempt. Before the burner can start the airflow switch must be in the open position to prove the switch is not giving a false signal of sufficient combustion air pressure.

H. The burner shall feature direct spark ignition.

I. Boiler safety controls shall include:

1. Operating Temperature Controller for automatic start and stop.
2. High Limit Temperature Controller with manual reset.
3. One Low Water Cutoff Probe in the boiler shell.
4. Air Safety Switch to prevent operation unless sufficient combustion air is assured.

J. Flame detector to prove combustion.
All controls are to be burner or panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls. All controls shall be mounted and wired according to UL requirements. Electrical power supplied shall be 208/230/460/3/60. A control circuit transformer shall be factory supplied, wired and mounted.

K. When multiple boilers are to be installed in a common hydronic loop, a Synex ModSync Boiler Sequencing System shall be used. Please refer to the specification for the ModSync for complete details of the parameters and capabilities associated with it.

## 2.5. MAIN FUEL TRAIN COMPONENTS

A. A factory mounted main gas train shall be supplied. The gas train shall be fully assembled, wired, and installed on the boiler and shall comply with CSD-1 code. Compliance with other codes is available upon request. The maximum pressure rating of the components shall not be less than one psi. The gas train shall consist of at least two manual shutoff valves, one gas pressure regulator, one automatic safety shutoff valve with prove of closure, one flow control valve, one high gas pressure switch, and one low gas pressure switch. The automatic safety shutoff valve and flow control valve may be the same valve. A pilot gas train, when supplied, shall comply with the same code and maximum gas pressure rating as the main gas train.

B. Standard CSD-1 fuel trains shall comply with IRI, which has been replaced by GE GAP. Normally open vent valves are no longer required between the safety shut off valves. NFPA 85 compliance shall be available from the factory to comply with local codes or regulations that specifically require a vent valve.

2.6. BOILER FITTINGS & TRIM

A. The boiler shall be supplied with an ASME Section IV safety relief valve. The safety relief valve size shall be in accordance with ASME code requirements.

B. The boiler shall be supplied with a temperature/pressure gauge to be mounted on the water outlet piping of the boiler.

C. A condensate drain connection shall be provided in the exhaust outlet. A Fulton condensate drain kit will be provided to collect and drain the flue gas condensate.

D. The water supply and return connections on the boiler shall be 150# flanged connections, 4” diameter for the VTG-2000/VTG-3000, and 6” diameter for the VTG-4000/VTG-5000/VTG-6000. The water connections shall not be designed to support any external structural load from the piping system.

E. The boiler shall come with lifting eyes and fork truck holes accessible for rigging.

F. Instructions for installation, operation and maintenance of the boiler shall be contained in a manual provided with each boiler.

G. A wiring diagram corresponding to the boiler configuration shall be included with each boiler.

H. A factory test fire report corresponding to the boiler configuration shall be included with each boiler.

2.7. EMISSIONS

A. When operating on Natural Gas, the boiler shall have CO emissions less than 50 ppm corrected to 3% O2 and NOx emissions less than 100 ppm corrected to 3% O2, over the entire turndown range.

2.8. DIRECT VENT

A. The boiler(s) shall meet safety standards for direct vent equipment as noted by the 2003 Uniform Mechanical Code, sections 802.2.5 and 1107.6, and ASH RAE 15·1994, section 8.13.6.

2.9. SOURCE QUALITY CONTROL

A. The boiler(s) shall be completely assembled, wired, and fire-tested prior to shipment from the factory.

B. The boiler(s) shall be furnished with the sales order, ASME Manufacturer's Data Report, inspection sheet, wiring diagram, rating plate and Installation and Operating Manual.

PART 3 – EXECUTION

3.1. INSTALLATION

A. Must comply with:

1. Local, state, provincial, and national codes, laws, regulations and ordinances
2. National Fuel Gas Code, NFPA 54/ANSI Z223.1 -latest edition
3. National Electrical Code, ANSI/NFPA 70 -latest edition
4. Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1, when required
5. Canada only: CAN/CGA 8149 Installation Code & CSA C22.1 CEC Part 1
6. Manufacturer's installation instructions, including required service clearances and venting guidelines

3.2. START-UP

A. Shall be performed by Fulton factory-trained personnel.

B. Test during operation and adjust if necessary:

1. Safeties (2.2·F)
2. Operating Controls (2.3)
3. Static and full load gas supply pressure
4. Gas manifold and blower air pressure
5. Amp draws of blower

C. Submit copy of start-up report to Architect and Engineer.

3.3. TRAINING

A. Provide factory-authorized service representative 10 train maintenance personnel on procedures and schedules related to start-up, shut-down, troubleshooting, servicing, and preventive maintenance.

B. Schedule training at least seven days in advance.

END OF SECTION 23 52 34

# SECTION 23 65 00 – PACKAGED COOLING TOWERS

## PART 1 – GENERAL

### 1.1. SUMMARY

A. Section includes packaged open-circuit, forced-draft crossflow cooling towers with structure, casing, fill and basin, controls, heaters fans, motors and drive equipment, condensing water inlet and outlet with internal distribution and ladder and handrails.

### 1.2. RELATED SECTIONS:

A. Section 03 30 00 – Cast-in-Place Concrete: Execution requirements for concrete bases specified by this section.

B. Section 22 11 00 – Domestic Water Piping: Execution requirements for makeup water and drain piping specified by this section.

C. Section 23 05 13 – Motors: Product requirements for electric drive motors for placement by this section.

D. Section 23 21 13 - Hydronic Piping: Execution requirements for tower supply and return piping specified by this section

E. Section 26 05 03 – Wiring Connections: Execution requirements for electrical connections specified by this section.

### 1.3. REFERENCES

A. ABMA 9 (American Boiler Manufacturers Association) – Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA 11 (American Boiler Manufacturers Association) – Load Ratings and Fatigue Life for Roller Bearings.

C. ASME PTC-23 (American Society of Mechanical Engineers) – Atmospheric Water-Cooling Equipment.

D. ASTM A90 – Standard Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

E. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.

F. Cooling Technology Institute (CTI): CTI STD-201 - Certification Standard for Commercial Water-cooling Towers' Thermal Performance.

G. CTI ATC-105 (Cooling Tower Institute) – Acceptance Test Code for Water Cooling Towers.

H. CTI STD-201 (Cooling Tower Institute) – Certification Standard.

I. NEMA 250 (National Electrical Manufacturers Association) – Enclosures for Electrical Equipment (1000 Volts Maximum).

J. National Electrical Manufacturers Association (NEMA).

1.4. SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting-bolt holes.

C. Product Data: Submit rated capacities, dimensions, weights and point loads, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls. Submit data indicating dimensions, rough-in connections, and electrical characteristics and connection requirements. Submit capacity and dimensions of manufactured products and assemblies required for this Project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections. Submit data for manufactured products and assemblies. Indicate water, drain, thermostatic valves, service maintenance and access clearances, and electrical rough-in connections with electrical characteristics and connection requirements.

D. Field Test Reports: Indicate compliance with cooling tower institute (CTI) ATC 105.

E. Manufacturer's Certificate: Certify cooling tower performance, based on CTI ATC-105, CTI STD-201, or ASME PTC-23 meet or exceed specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.

F. Manufacturers Field Reports: Indicate compliance with field test if applicable.

1.5. CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories.

1.6. QUALITY ASSURANCE

A. Electrical components, devices and accessories: UL-listed components and labeled per UL and NEC requirements.

B. Cooling Technology Institute (CTI) Certification: Cooling tower thermal performance at design conditions according to CTI STD-201 - Certification Standard for Commercial Water-cooling Towers' Thermal Performance.

C. ASHRAE: 90.1 Compliant.

1.7. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.8. PRE-INSTALLATION MEETING

A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this section.

1.9. DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

B. Follow manufacturer's installation instructions for rigging, unloading, and transporting units.

1.10. FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11. WARRANTY

A. Section 01 70 00 – Execution Requirements: Product warranties and product bonds.

B. Warranty: Provide cooling tower manufacturer's standard material and labor warranty, in accordance with conditions specified within written warranty. Towers not covered by a warranty of this scope will not be accepted.

1. External Shell: Fifteen years from date of shipment from factory. Excludes normal wear and tear and cosmetic and superficial damage.
2. Internal Components and Fans: Five years from date of shipment from factory.
3. Fill Media and Drift Eliminators: Five years from date of shipment from factory.
4. Cold Water Basin and Tower Casing: Fifteen years from date of shipment from factory.
5. Motors, Sump, Water Collection Devices, Fans: Five years from date of shipment from factory.
6. Labor: One year from date of substantial completion.

1.12. MAINTENANCE SERVICE

A. Section 01 70 00 – Execution Requirements: Maintenance service.

B. Furnish service of cooling tower for ONE years from Date of Substantial Completion.

1.13. EXTRA MATERIALS

A. Section 01 70 00 – Execution Requirements: Spare parts and maintenance products.

B. Furnish two spray nozzles for each cell.

C. Furnish two gaskets for each access door.

D. Furnish one valve seat for each make-up or control valve.

PART 2 – PRODUCTS

2.1. COOLING TOWERS

A. Manufacturers:

1. Tower Tech
2. Substitutions: Refer to Section 22 05 13 – Basic Mechanical Material and Methods and Section 22 05 00 – General Mechanical Requirements.

B. All cooling towers must be completely non-corrosive with no galvanized metal allowed on any part of tower. All FRP tower shall have minimum ¼" thickness on walls.

C. All cooling towers shall be certified for 200 mph wind loads.

## 2.2. COOLING TOWERS - GENERAL

A. General Requirements: Furnish and install as shown on the plans a factory-assembled, forced draft, counter-flow, modular cooling tower.

1. Design Loading: As indicated on Drawings.
2. Design Loading: Tower shell and substructure (support legs) shall be designed to withstand a sustained wind load of 200 mph.
3. Seismic: force factor of Cs = 0.4 x weight, category D (Ss = 200, S1 = 150, soil class E) as referenced in the International Building Code 2015.

B. System Requirements: Cooling tower modules must be capable of operating independently or in combination with future modules.

1. Minimum Cells or Modules: As indicated on Drawings.
2. The cooling tower's principal construction shall be of pultruded Fiberglass Reinforced Polyester (FRP) and must have a flame spread rating less than 25 (ÅSTM E 84) or a flammability coefficient of 94-V0.
3. Cooling towers constructed of metal shall have basin, panels, and structural elements manufactured from stainless steel to equal corrosion resistance of fiberglass.
4. Stainless Steel Alloy: 304.

## 2.3. CONSTRUCTION

A. Cold Water Basin and Tower:

1. The cold-water basin and the tower casing shall be constructed of pultruded Fiberglass Reinforced Polyester (FRP) with UV inhibitors.
2. FRP
   a). Minimum Thickness: 1/4 inch
   b). Minimum Density: 0.7 oz./cu. in.
3. Specially placed reinforcement and an ultraviolet veil layer will ensure the structural strength and longevity.

4. Perimeter Basin: External shell.
5. Tower shell or casing shall have an integral perimeter basin. Its elevated basin shall reduce operational pump head requirements.
6. High Velocity Water Flow: 5-7 feet per second during operation shall minimize accumulation of sediment.
7. Perimeter Basin: Equipped with one inspection port, at each corner support member, on the front and rear surfaces.
8. Basin shall be equipped with a pair of 2-inch NPT stainless steel drain connections located on opposite sides of the tower perimeter basin floor, and mid-basin inspection ports located in the floor of the tower water basin, between each set of fans.

B. Basin Heaters: As indicated on Drawings.
1. Basin Heaters: Two 6kW stainless steel basin heater elements.
2. Heater shall have corrosion and liquid proof enclosure.
3. The basin heater package shall include a combination controller and probe (temperature and level sensor) preset at 45 degrees F (7.2 degrees C). This sensor probe is stainless steel with a 1/2-inch NPT mounting fitting.
4. The control panel contains the electronic temperature/flow liquid level control, control voltage transformer, and magnetic contactor used to energize and de-energize heater.
5. Heater must be interlocked with pump control to deactivate heaters when cooling tower pumps are operating.

C. Control panel door includes standard lockout disconnect.
1. Panel and probes shipped loose for field install.
2. A separate 3-Phase power source must be supplied to the control unit.
3. Interlock with pump control and flow/pressure switch to be completed in the field by others (temperature controls contractor or electrician).
4. Compliance: Control panel is NEMA-4X, UL rated.

D. Towers with conventional basin designs shall provide a "Sweeper" piping system to prevent sediment buildup and/or stagnant water areas that permit algae and other biological growth. Sweeper piping system shall include necessary "Eductor" nozzles, piping, pump, sediment separator, and electronic controllers for a completely automatic system.

E. Sump: Mechanical component.

1. Tower shall be equipped with a terminally mounted (end wall) outlet sump with a bottom outlet providing a flanged 150 lb. bolt pattern discharge connection for simplified piping. Sump casing shall be manufactured of rotationally molded Polypropylene (PP). Towers having depressed center-type sumps shall use 304 stainless steel for sump construction.

2. Standard equipment shall include a manufacturer supplied and mounted brass float valve with brass or stainless-steel components.
3. Connection Size: As indicated on Drawings.
4. Also included are a flanged overflow/equalization connection, and a corrosion-free, easily removable debris screen. Contractor to be responsible for modifications and additions for towers that utilize alternative equalization and overflow designs.
5. Maximum Rated Operating Pressure for Float Valve: 25 psi.
6. Install pressure reducing valve if site water pressure is above 25 psi.
7. Fill and Drift Eliminators: Internal component.
   a). Fill shall be Polyvinyl Chloride (PVC) of cross-fluted design, 10-mil after forming, impervious to decay, fungus and biological attack, with a flame spread index of 5 according to ÅSTM E 84 and a maximum operating temperature of 130 degrees F (54.4 degrees C). Fill sheets shall be self-spacing, supported on maximum spans of 12 inches (305 mm). Each fill sheet shall have a microstructure to improve heat transfer. Fill sheets shall be bonded together to form a cross-corrugated pattern by application of glue to dedicated glue joints or by engineered mechanical attachment. Where glued, random application of glue shall not be acceptable.
   b). The flute opening of the fill pack shall not be less than around 3/4 inch (19 mm). Fill packs or blocks shall be placed in the tower so as to provide the tightest fit possible without damage to the fill.
   c). Drift eliminators shall be minimum three-pass Polyvinyl Chloride (PVC) material of cellular design impervious to decay, fungus and biological attack, with a flame spread index of 5 according to ÅSTM E 84 and a maximum operating temperature of 130 degrees F (54.4 degrees C). Drift losses shall not exceed 0.0004 percent of the design circulating flow rate at full fan speed.
8. Water Distribution Systems: Internal component.
   a). Water shall enter the tower through a single inlet comprised of an enclosed, low pressure, non-corrosive Polyvinyl Chloride (PVC) Schedule 40 piping system Water shall be evenly sprayed over the fill media by evenly spaced and be Spin-Free Nozzles that can accommodate a variable flow rate. The nozzles shall have a 2-inch NPT connection and rotating disk for clog free operation, produce a square pattern, and shall be installed not more than 3 inches (762 mm) above the fill media.
   b). Nozzles shall be capable of a variable flow of 25 gpm to 75 gpm to while maintaining full coverage of fill media. Towers that utilize a hot water gravity basin design shall be constructed of 316 stainless steel, and the hot water basin covers shall be constructed of stainless steel or corrosion resistant material of equal quality.

c). Hardware used for securing panels to basin shall be stainless steel.

d). Towers operating with fixed orifice nozzles shall include a ladder equipped with safety cage and a fan deck handrail system to provide access to the gravity distribution basin or nozzles for routine maintenance. The water distribution system shall provide full fill media coverage through the entire operating flow range of the circulating water system.

e). Water Collection Systems: Internal component.

1). The tower shall utilize a water collection system positioned beneath the fill media and above the air inlet.

2). The water collection system shall collect cold water as it falls from the fill media and channel the water into the tower's elevated perimeter basin permitting the mechanical equipment to be mounted in the dry entering air stream beneath the tower.

3). The water collectors shall be made of extruded flame-retardant acrylonitrile butadiene styrene copolymer (ABS) material and shall contain an integral barometric damper system that causes the dampers to open and close mechanically with airflow.

f). Each fan's damper system will prevent entry of airborne debris into the tower when the fan below the damper is OFF.

g). For towers utilizing an open sediment-type basin design, air inlet louvers shall be installed, and the following type of louvers installed.

1). Louvers Materials: FRP.

9. Motors: Mechanical component.

a). Motors: A minimum of two equally sized motors shall be provided. Tower modules offering a single motor for the design conditions shall be unacceptable.

b). Motors Per Tower Module: As indicated on Drawings.

c). Motors Per Tower Module: two

d). Power: 3 HP x 4 motors, 12 hp per tower module

e). Power: As indicated on Drawings.

f). Service Factor: As indicated on Drawings.

g). Must be Suitable For: Voltage as indicated on Drawings.

h). At Service Temperature: As indicated on Drawings.

i). Motors: Inverter ready, RPM as indicated on Drawings.

j). Motors: Inverter ready, nominal 860 RPM.

k). Wiring: As indicated on Drawings.

l). Wiring: Motors shall be factory pre-wired using oil resistant, VFD compatible, quantum-shielded cable connected to a NEMA-4X junction box which allow service to be performed on an offline fan/motor while the remaining fans continue to operate. This pre-wiring shall be wired to a Motor Protection Panel Mounted on the

tower as indicated on drawings (see Motor Protection Panel information below…)

m). Towers having motors located in the exit air stream are not acceptable. Towers having motors with greater than 7.5 HP (5.6 kW) per motor shall provide a davit system designed to remove motors from top of tower to base of tower

n). Motors in each cooling tower module shall be connected to and operated by a single variable-frequency drive (VFD), having maximum motor current of 24.6 amps, housed in an enclosure. Single-winding; equipped with a VFD with 3-contactor automatic bypass.

o). Enclosure Rating: As indicated on Drawings.

p). Drive to have 3-contactor automatic bypass connected to fans on a cooling tower module. Fans in each cooling tower module shall be modulated equally.

F. Fans: Mechanical component.

1. Each tower module shall have a minimum of two fans to handle the design conditions.
2. Fans shall be of an axial, airfoil design positioned within an aerodynamically streamlined fiberglass shroud and installed with a minimum tip clearance for maximum efficiency. Fan blades shall be manufactured of Fiberglass-Reinforced Polypropylene and be pitch-adjustable. Fan hubs shall be manufactured of high strength, low weight aluminum alloy to minimize stress and wear on motor bearings.
3. Direct-Drive Fans Per Tower Module: eight.
4. The fan assembly and motor shall both be located outside exiting air stream.

G. Doors,

1. Doors, external ladders, platforms, and handrails: Towers having fans located on the top shall be equipped with fixed ladders with ladder extensions to access top of cooling tower from adjacent grade without the need for portable ladders.
2. Handrails, knee rails, toe boards around the top of tower shall be supplied.
3. Towers having access doors to internal components shall provide internal platform spanning the collection basin from one end of the tower to the other and positioned to form a path between access doors. Platform shall be elevated so that parts remain above the high-water level of the collection basin.

## 2.4. CAPACITY: REFER TO SCHEDULE ON DRAWINGS.

## 2.5. ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. The unit shall come with single point connection for the cooling tower. The factory mounted control panel shall have the main units disconnect and all

motor and heater starters, disconnect and interlocking control wiring shall be prewired in the unit. If unit is delivered in section the section shall be prewired such that on the connection wiring is done in the field.

B. Section 26 05 03 – Wiring Connections: Requirements for electrical characteristics.

C. Section 23 05 13 – Motors: Requirements for motors.

D. Disconnect Switch: Factory-mount in control panel on equipment.

2.6. COOLING TOWER MOTOR PROTECTION PANEL

A. Motor Protection Panel (MPP) shall be a UL-Rated NEMA 4X (FRP) and designed for single point connection. The NEMA 4X panel shall have individual manual motor protectors to protect each motor against short circuit or thermal overload. The manual motor protectors shall have built-in adjustable motor overload for setting to motor Service Factor Amps (SFA). Each device shall have an On/Off rotary handle with lock out/tag out capability and visible trip indication for each individual motor. Each manual motor protector shall have an auxiliary contact to provide a dry contact status of the motor back to the University Delta V control system. The NEMA 4X panel also provides a main non-fused disconnect with through the door operator handle. The MPP is pre-wired to the motors and pre-mounted on the cooling tower. The MPP shall be configured to allow for bottom entry of cables.

B. Each A separate (4-20ma, scale 30°F-200°F) temperature RTD probe, with W' NPT male connection and W' NPT male SS thermal well, shall be supplied loose for field installation in the cooling tower cold water piping. The probe shall be wired back to the Variable Frequency Drive (VFD), using 3-wire shielded cable, to provide a cold-water temperature signal for proper fan speed control by the VFD.

C. VFD shall be equipped with a (4-20ma scale, 30°F-200°F) cold-water temperature "Remote Set Point" input. This feature allows the cold-water temperature set point to be modified via the University Delta V control system. This overrides cold-water set point manually input (default) via the operator interface panel at the VFD. In the event the Delta V signal is lost, the VFD control reverts back to default set point. VFD shall be equipped with internal PID closed loop controller to ensure accurate frequency conversion of the cold-water signal from the RTD to determine the output frequency to the motors for maintaining “Set Point” input.

D. The MPP shall be equipped for interconnection with the Variable Frequency Drives (VFD) supplied. When the VFD Bypass is engaged, or

drive failure occurs, the MPP shall energize all fan motor starters, with fan motors operating at full speed.

E. Internal MPP wiring shall be fine stranded, tinned copper switchboard wire with 600V flame- retardant insulation Type SIS meeting UL 44 and shall pass UL VW-1 flame test. Minimum size shall be #14AWG. Provide type written, sleeve type conductor labels on all internal cabinet wiring. Sleeves shall be PVC, type written, shrinkable type that shall correspond to the cabinet wiring diagrams and schematics. Text shall not be less than ¼" in height.

F. All Variable Frequency Drives (VFD's) shall be sized according to Total Connected Amps (including all applicable service factors required by governing Electrical Codes), not total connected HP (kW). Include DV/DT filters for motor protection against voltage spikes.

G. Variable Frequency Drives (VFD's) shall be mounted indoors and shall be NEMA 1 rated with auto bypass.

H. For towers that are designed with one motor per cell, a NEMA 4 starter/control panel and NEMA 1 VFD with auto bypass shall be provided for each motor.

## PART 3 – EXECUTION

### 3.1. PREPARATION

A. Do not proceed with installation until substrates have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

B. Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Verify substrate and framing is acceptable for product installation.

C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

### 3.2. INSTALLATION

A. Install Work in accordance with State of Texas Public Work's standards.

B. Install tower on concrete base in accordance with manufacturer's published instructions.

C. Install condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower.

D. Install make-up water piping with flanged or union connections to tower. Pitch to tower.

E. Install overflow, bleed, and drain, to grade

F. Install equipment with and maintain all service clearances as required or recommended by the manufacturer.

## 3.3. FIELD QUALITY CONTROL

A. Section 01 70 00 – Execution Requirements: Testing, adjusting, and balancing.

B. Test for capacity under actual operating conditions in accordance with CTI ATC-105 and verify specified performance.

## 3.4. MANUFACTURER'S FIELD SERVICES

A. Section 01 45 00 – Quality Requirements: Manufacturers' field services.

B. Supervise rigging, hoisting, and installation; include eight-hour days per tower.

C. Inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturers recommendations.

## 3.5. CLEANING AND PROTECTION

A. Clean products in accordance with manufacturer's instructions.

B. Protect installed products from damage by subsequent construction activities.

C. Touch-up, repair or replace damaged products before Substantial Completion

## 3.6. ADJUSTING

A. Section 01 70 00 – Execution Requirements: Testing, adjusting, and balancing.

B. Adjust bleed, control settings and airflow.

3.7. DEMONSTRATION AND TRAINING

A. Train Owner's maintenance personnel to operate and maintain cooling towers and controls including:
   1. Starting and stopping of fan motors.
   2. Sequence of operation.
   3. Troubleshooting and servicing.
   4. Routine maintenance.
   5. Schedule training with owner, through Engineer.

B. Demonstrate starting, maintenance and operation of tower.

3.8. SCHEDULES:

A. Refer to schedule on drawings.

END OF SECTION 23 65 00

# SECTION 26 05 00 – ELECTRICAL GENERAL PROVISIONS

## PART 1 – GENERAL

### 1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

### 1.2. DESCRIPTION OF WORK:

A. Drawings: Refer to the E-series drawings for graphic representations, schedules and notations showing electrical work.

B. Specifications: Refer to the Division 26 sections for the primary technical specifications of electrical work.

C. This work includes furnishing and installing all electrical material, accessories, supports, conduit, wire, connections, grounding, excavating and all other labor and materials indicated on the drawings or specified herein and required by codes. This includes all electrical materials and connections required for operation of all items of equipment furnished under other sections of these specifications. For clarity some items may be noted as "BY ELECTRICAL CONTRACTOR" or "IN THIS CONTRACT".

D. Work Included:

The work under this section is not limited to, but shall include:

1. Electric service conduits and cables and utility company service charges.
2. Trenching, excavating and backfilling for electrical work.
3. Permit, plan check and inspection fees.
4. Any fees or assessments required by local authorities are a part of the electrical contract.
5. Main metering switchboard, panelboards and feeders for a complete power and lighting distribution system.
6. Lighting fixtures, lamps, outlet boxes, conduit, wiring devices, control components, buck-boost transformers, powers supplies for low-voltage lighting fixtures, and accessories.
7. Conduit, wiring and connections for all line voltage electrical equipment furnished and installed by others (see Mechanical, Refrigeration, Fire Control drawings).
8. Conduit and wire for low voltage controls. Final connections by electrical contractor.

9. Starters and disconnects for all fan motors. These shall include all components to make shunting under hoods fully operational.
10. Motors.
11. Connection of low voltage wiring to air conditioning controls (except as shown on plans).
12. Occupancy sensor low voltage circuits/power paks.

E. Equipment provided under other sections, but connected under this section:

1. Mechanical.
2. Signs.

1.3. BIDDING

A. All electrical equipment shall be new unless specified otherwise in the specifications or on the drawings.

B. All bids must be based only on the equipment and materials as scheduled on the drawings and as specified or on equivalent equipment and materials from a pre-approved alternative manufacturer. No bid may be based on a substituted or other alternative without specific written prior approval from the Engineer. Any Contractor who assumes equivalence of products and who bases his bid on that assumption does so at his own risk.

C. A listing of approved alternative manufacturers does not mean that all products of a particular alternative manufacturer are acceptable alternative to the scheduled items; it merely means that for bidding prior approval is not required. All fixtures and devices must still be submitted according to the prescribed procedures. In addition, some items that have an important visual affect, e.g. electric water coolers, may be required to receive Owner's or Engineer's approval also.

1.4. COORDINATION OF ELECTRICAL WORK:

A. General: Refer to the Division 1 sections for general coordination requirements applicable to the entire work. It is recognized that the contract documents are diagrammatic in showing certain physical relationships, which must be established within the electrical work, and in its interface with other work including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Electrical Subcontractor.

B. Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of the building construction, and with a minimum of 8'-0" overhead clearance where possible.

C. The electrical plans are diagrammatic, but shall be followed as closely as actual construction and the work of the other trades will allow. Such minor changes as are necessary to make the electrical work conform to the work of other trades and to the building shall be made without cost to the Owner.

D. The maximum number of circuits combined in one raceway shall be three; however, no circuit shall be combined without prior approval of the Engineer or unless specifically shown on the drawings.

E. The Electrical Subcontractor shall not combine circuits not shown to be combined. Furthermore, this electrical subcontractor shall not extend circuits, shown on the drawings as routed in the floor, overhead or extend circuits, shown on the drawings as routed overhead, in the floor, without first obtaining approval from the Engineer. This electrical subcontractor shall not prepare and/or use electrical subcontractor prepared rough-in drawings without first obtaining approval from the Engineer.

F. Where unauthorized design changes are found, the work shall be disapproved and the contractor shall remove the work and extend it as shown on the Drawings.

G. The Electrical Contractor shall coordinate the installation of electrical conduits with any cable tray to maintain required clearances.

1.5. QUALITY ASSURANCE AND STANDARDS:

A. General: Refer to Division 1 for general administrative/procedural requirements related to compliance with codes and standards. Specifically, for the electrical work (in addition to standards specified in individual work sections), the following standards are imposed, as applicable to the work in each instance:

1. ANSI C 2, National Electrical Safety Code.
2. NECA standards for installation.
3. NEMA standards for materials and products.

1.6. LAWS, CODES AND ORDINANCES:

A. All work and material shall conform to the requirements of OSHA and all national and state Laws and ordinances having jurisdiction at the job site. The (NEC) National Electrical Code, 2017 Edition, or latest edition being enforced, shall be strictly adhered to. NEC requirements are considered "minimum requirements". Where requirements of the contract documents exceed NEC, the contract documents govern.

B. Secure permits and pay permit and inspection fee as required by local authorities.

C. Upon completion of the work, furnish to the Owner a certificate of final inspection and approval from the electrical inspection bureau having jurisdiction.

D. All electrical systems shall be grounded in strict accordance with the requirements of the National Electrical Code.

1.7. INDUSTRY PUBLICATION STANDARDS:

A. The publications and standards of the latest issue at the time of bid, of the following organizations, where referenced in these specifications or on the drawings, shall apply:

1. ANSI-American National Standards Institute
2. ASTM-American Society of Testing and Materials
3. CBM-Certified Ballast Manufacturers Association
4. IEEE-Institute of Electrical and Electronic Engineers
5. IPCEA-Insulated Power Cable Engineers Association
6. NEC-National Electrical Code
7. NECA-National Electrical Contractors Association
8. NEMA-National Electrical Manufacturers Association
9. NESC-National Electrical Safety Code
10. NFPA-National Fire Protection Association
11. UL-Underwriters Laboratory
12. IESNA-Illuminating Engineering Society of North America

1.8. EXISTING UTILITIES

A. The drawings indicate the locations, type and sizes of various utilities within the site where known. These utilities are indicated as accurately as possible. If the Contractor encounters any utilities or differing conditions during construction, which are not shown on the drawings, they shall request in writing for written instructions from the Engineer. Any relocation or remodeling required will then be directed by a change order. This Contractor shall assume all responsibility for protection of all utilities, shown or not, and for repair required by this construction.

B. Contractor shall verify location, size, elevation, and any other pertinent data of the existing utilities. The Contractor shall provide a written report with drawings indicating this existing utilities information, such as utility locations information. Additional costs incurred due to failure to verify such data and to coordinate associated work with respective utility providers shall not be the Owner's responsibility but shall be borne by the Contractor.

C. All costs associated with providing utilities including, but not limited to, connection fees, meters, boring under roads, etc., shall be included in the Contractor's bid price whether such costs are incurred by Contractor or charged by the utility company.

D. Submission of a bid by the Contractor shall be considered an acknowledgment by the contractor of his compliance with this section.

E. The Contractor shall coordinate with Owner and this Engineer's office any work that has the potential to hinder electrical services to areas outside this contract. All shut downs or tie-ins relating to these systems shall be scheduled and submitted in writing to be approved by the Owner and this Engineer's office. Contractor shall submit in writing a schedule of construction phasing that indicates areas of first priority during each phase and anticipated completion times. Schedules shall be submitted a minimum of 7 days prior to commencing work. Owner and this Engineer's office shall review these schedules and notify the contractor of acceptance prior to commencement of work.

1.9. DRAWING AND DRAWING CONFLICTS

A. Contract drawings are diagrammatic only and are not intended to be scaled for dimensions. All dimensions shall be taken from certified equipment drawings and from the structure itself before fabricating and work. All space requirements shall be verified, coordinated with other trades, as it is the various Contractors' responsibility to install the systems complete in the space provided without extra charges to the Owner.

B. It is intended that anything, including labor and materials, which is usually furnished as part of any equipment specified and which is necessary for operation shall be furnished as part of the Contract without additional cost, whether or not shown or described.

C. All piping in finished areas of the building shall be concealed except where otherwise noted on the drawings.

D. All equipment shall be installed in accordance with manufacturer's recommendations, unless approval is given in writing be the Consulting Electrical Engineer for deviation prior to commencement of work.

E. In the event of a conflict or inconsistency between items indicated on the drawings and in the specifications or conflicts with code requirements applying to the same item, that drawing indication, note, specification or code which prescribes and establishes the higher standard, provides for a better grade of material or provides

a more complete job shall take precedence. The Contractor shall notify Engineer to obtain a clarification.

F. All materials not approved by Engineer and all material not properly installed, shall be promptly removed from the premises by the Contractor, whether or not it has been incorporated into the work. The Contractor shall then promptly replace and reconnect all work in accordance with the drawings and specifications, at his own expense, and shall also bear the expense of restoring all work of other trades damaged or dislocated by such removal or replacement.

G. Should the Contractor refuse to remove and replace unsatisfactory materials and installation and restore work of other trades after having been notified by Engineer, then Engineer and owner shall have the right to enter upon the work and procure such materials and labor required to remove and replace all unsatisfactory work and restore work of other trades, in order to complete the project. All costs incurred by Owner/Engineer for such corrective work shall be borne by the Contractor.

H. Submittals shall indicate minimum access and service clearances for the submitted equipment.

1.10. STRUCTURAL CONDITIONS - SPECIAL NOTE

A. Where conduits, sleeves, inserts, supports, cabinets, fixtures and other material are to be attached to, pass through, or interfere with, any structural member, or where notching, boring or cutting of any structural member is necessary, or where special openings are required through floors, footings, foundations, walls, roofs, or other structural elements to accommodate the electrical work, this Contractor shall obtain the approval of Owner/Engineer and shall coordinate all such work with the General Contractor, and other trades. The Electrical Contractor shall perform all such work and shall patch and repaint all members and surfaces damaged or soiled in performing the electrical installation, unless specifically instructed otherwise.

B. Where conduits pass through walls or foundations, seal around conduits to make the work watertight. Where conduits pass through roofs, provide galvanized metal flashing and seal with a suitable compound, intended for the purpose to make the work watertight.

C. See schematics and plans for conduits through roof on M/E/P drawings.

1.11. WARRANTY

A. All materials and equipment shall be new unless otherwise specified.

B. Guarantee all workmanship, material and equipment and replace any found defective without cost to the Owner, for ONE year after final acceptance, as defined in General Conditions.

C. Each warranty for longer than one year as described above (that comes with equipment used on the job) shall be passed into the Owner in the Operation and Maintenance Manual, along with the dates of start and end of warranty.

D. Refer to General Conditions for additional information regarding specific warranty requirements.

1.12. PROJECT RECORD DOCUMENTS

A. Before final payment, provide the Engineer with one clean set of drawings and specifications corrected up-to-date as job progress. These documents shall reflect the As-Built conditions. Refer to General Conditions for additional information.

1.13. SUBMITTALS

A. The intent of this section is to give general submittal information, refer to specific submittal information in the subsequent electrical sections.

B. Within 10 days after award of the contract, and before orders are placed, Contractor shall submit specific information on list of equipment and principal materials specified. Contractor shall indicate and/or provide names of manufacturers, catalog and model numbers, cut sheets, and such other supplementary information as necessary for evaluation. Minimum of six (6) copies, or as directed by the Engineer, of each shall be submitted and shall include all items mentioned by model number and/or manufacturer's name in the specifications or in schedules on the drawings.

C. Requirements for each submittal:

1. Bear a dated stamp or specific written indication that the Contractor has reviewed and approved all submittal prior to submission to Engineer,
2. Have all information deleted by Contractor that pertains to the means and methods of construction or to fabrication, assembly, installation, or erection (approval by Engineer shall not extend to these areas unless specifically noted by Engineer),
3. **BE CLEARLY AND SPECIFICALLY** marked as to which specific piece of equipment is being submitted, bye use of a permanent marker, stamp, etc., so as to distinguish it from other pieces of equipment that may occur on the same page,

4. **BE CLEARLY AND SPECIFICALLY** marked as to which available options are being submitted that are associated with a piece of equipment, and
5. Be complete with respect to quantities, dimensions, specific performance, materials, and similar data to enable the Engineer to review the proposed equipment.
6. **BE CLEARLY AND SPECIFICALLY** marked as to any and all submittal deviations from the design specification requirements shall be provided in written form.
7. Omission by Contractor of any of the above requirements or submittals will subject submittal to automatic rejection without review.
8. Any submittals received by Engineer that were not requested shall be returned without review of any kind.

D. Installation Instructions - For certain products or systems as identified in subsequent specifications sections or on the drawings, the Contractor shall be required to provide copies of manufacturer's installation instructions with the submittal. When required as such, the installation instructions are considered part of the submittal and their omission may result in automatic rejection of the submittal. Where more than one identical device are scheduled, only one set of installation instructions needs to be submitted, e.g. if seven 200A panels are scheduled; only electrical panel installation instruction needs to be submitted. Similarly, if one set of installation instructions is identified by the manufacturer and on the instructions to be applicable to more than one type or size of devices, e.g. if one set of panel instructions is good for 100A, 150A,200A, electrical panels, then only one instruction set is required for these devices.

E. This Engineer will review the submittals for approval twice. Any additional reviews that are required by the engineer for whatever reason after the initial two reviews will result in additional compensation for the Engineer's time by the submitting Contractor at the Engineer's rate.

1.14. PRIOR APPROVAL OF SUBSTITUTED PRODUCTS

A. Material or equipment specified by Manufacturer's name and model number is being used as a basis of standard and performance. No substitution is allowable without Engineer's written approval **FOURTEEN (14) DAYS PRIOR TO BID DUE DATE** unless the manufacturer is listed on the drawings or in the specification as being a preapproved alternative manufacturer.

B. A prior approval submittal package shall at a minimum consist of the following items:

1. One copy of the product submittal in accordance with the paragraph in this section titled SUBMITTALS.

2. Plan layouts sketches of mechanical rooms or systems of the substituted equipment showing that the proposed equipment will fit within the space allocated with the manufacturers and code required clearances for the substituted equipment as well as the other equipment in the space.
3. Indications of any structural modifications required for the proposed substitution, such as additional weight or opening size changes.
4. Indications of any electrical modifications required for the proposed substitution, such as changes in breaker sizes, wiring requirements.
5. Indication of any deviations from the specified equipment or their performance.

C. It shall be the Manufacturer and/or their authorized Representative's responsibility to verify that submitted substitute equipment will fit in space available. The Manufacturer and/or their authorized Representative's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but complete.

D. The Manufacturer and/or their authorized Representative's shall be responsible for the costs of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete, that is, it shall include the cost effect of any and all other trades.

1.15. SUBSTITUTED PRODUCTS

A. Material or equipment specified by Manufacturer's name is being used as a basis of standard. No substitution is allowable without Engineer's written approval **FOURTEEN (14)** days prior to bid due date unless the manufacturer is listed on the drawings or in the specification as being a preapproved alternative manufacturer. Any submittal received without such written approval or prior approval is subject to unqualified rejection.

B. It shall be the Contractor's responsibility to verify that submitted substitute equipment will fit in space available. The contractor's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but complete.

C. The Contractor shall be responsible for the costs of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete, that is, it shall include the cost effect of any and all other trades.

D. The Engineer may request detailed shop drawing or plan layouts of mechanical rooms or systems of the substituted equipment.

E. Should a substitution be approved by the Engineer (based upon the substitution submittal) and accepted, and should the substitute material or equipment prove defective, not meeting design parameters, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.16. SAFETY

A. General – Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work, and Contractor shall comply with all laws governing safety, specifically the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", state and federal.

B. According to OSHA, a hazardous chemical is any chemical, which is a physical hazard or a health hazard. This may include items such as paints, solvents, adhesives, sealants, cleaners, etc. If a contractor produces, uses, or stores hazardous chemicals at the workplace, then contractor shall develop, implement, and maintain a hazard communication program in compliance with the latest OSHA requirements. In projects with multiple tenants in which the building is partially occupied during all or part of the project, Contractor shall inform the building manager or Owner, according to OSHA guidelines, of any hazardous chemicals being produced, stored, or used in the building so that other tenants may be notified. Contractor shall employ required methods of training, information, handling, ventilation, labeling, storing, disposal, and removal of hazardous chemicals.

1.17. LABELING

A. Each device for which an independent testing authority has established a standard shall have affixed a label indicating its compliance and listing. Refer to General Conditions for list of such independent testing authorities.

1.18. SITE VISIT REPORTS

A. During the course of the job, the Engineer will make site visits to observe work in progress and will subsequently prepare a written site visit report, which will be sent to the Contractor and to whomever else the Engineer desires. The Contractor shall prepare a written and typed response within seven (7) calendar

days of his receiving the site visit report. The General Contractor shall include in his response the following information.

1. Date of site visit by the Engineer,
2. Date of receipt of the site visit report,
3. Name and title of the preparer of the response,
4. An item number referenced to the site report,
5. A brief three or four word description of the item,
6. The Contractor or Subcontractor affected,
7. The proposed course of action, and
8. An expected time of completion of the action.

1.19. CUTTING AND PATCHING

A. No joists, beams, girders, columns, slabs, or other structural elements shall be cut, drilled, or altered in any way by the Contractor without first obtaining written permission and instructions from the Engineer.

B. Where it is necessary to cut through any non-structural elements of walls, floors, or ceilings to permit the installation of any work under this contract, or to repair any defects that may appear up to expiration of the guarantee, such cutting shall be done by the Contractor with as little damage as reasonably possible to the element being cut or to adjacent elements.

C. After the necessary work has been completed, the damage shall be repaired by the respective Contractor, who shall pay all costs of such cutting, repairs and patching. All patching or sealing of cuts and penetrations, including final appearance of same, shall be done to the approval of the Engineer.

1.20. INSURANCE

A. The Contractor shall have required insurance. Required insurance shall be provided by this Contractor for protection against public liability and property damage for the duration of work.

1.21. CONFLICTS AND CORRECTION OF WORK

A. Promptly correct work rejected or failing to conform to the requirements of the Contract, whether observed before or after substantial completion and whether or not fabricated, installed or completed. The Contractor shall bear cost of correcting such rejected and nonconforming work including additional testing and inspections and including compensation for observing mechanical and electrical engineering firm's services and expenses made necessary thereby.

B. If a conflict occurs on the bid documents, the Contractor shall contact the Engineer's offices with a written request for clarification. If the conflict is un-resolvable at the time of bid, the most expensive interpretation of the conflict shall be bid so the conflict can be resolved in a deductive manner at a later time if necessary.

C. If a conflict is discovered during construction, the Contractor shall stop work and that portion of the project and contact the appropriate party for clarification. The request for clarification shall be in written form. The Contractor shall bare the burden of replacing work that has been installed incorrectly as a result of a conflict on the drawings where he has not sought the Engineer's guidance for clarification.

1.22. COMMISSIONING

A. Coordinate all work with the commissioning agent and the commissioning specifications.

1.23. COORDINATION

A. In a timely manner, and coordinated with all work involved, prepare and submit a trade composite work plan to be integrated into the Commissioning Plan for the following areas:

1. Where new work of three or more trades or subcontractors is installed.
2. Where lead times are critical to the project schedule.
3. Provide construction grade drawing as needed to acquire approval of work plan.
4. Access or service spaces required for Electrical equipment.

B. Provide final coordination plan to be integrated into the Commissioning Plan to account for:

1. Matching the work to the final selection of equipment; incorporating manufacturer's published instructions into the design;
2. Changes in equipment arrangement, and associated changes in equipment piping, ducting, and electrical work different from what is shown or specified;
3. Changes by manufacturer between date of design and date of delivery of equipment;
4. Relocations resulting from more than one trade being shown or specified in these drawings and specifications in the same location;
5. Addition of minor structural, mechanical, and electrical work for a complete system;
6. And similar circumstances as described above;

7. Work shall not be installed prior to written reply acknowledging that coordination drawing submittals have accomplished the specified intent of coordination. Relocations of work installed prior to coordination drawing acknowledgment, if subsequently required to avoid interference, shall be made.

PART 2 – PRODUCTS

2.1. MATERIALS AND EQUIPMENT:

A. General: Refer to Division 1 sections for general requirements on products, materials and equipment. The following provisions expand or modify the requirements as applicable to electrical work:

B. Materials List: Within 15 days after award of contract, the Electrical Subcontractor shall submit to the Engineer a list, seven (7) copies, of all equipment, fixtures, materials, etc. to be furnished. Where such equipment will be furnished "as specified", a listing of the specific equipment manufacturer to be used on this project is sufficient. Where substitutions are proposed, complete data must be furnished showing performance, quality and dimensions. Written approval of the Engineer must be obtained before purchasing any substitute equipment.

C. All materials shall be new and shall bear the label of the Underwriter's Laboratories, Inc., or be listed under reexamination service. All materials shall be of the best grade and latest pattern of manufacturer as specified.

D. All work shall be performed in a neat, workmanlike manner and shall present a neat electrical appearance when completed.

E. All similar materials and equipment shall be the product of the same manufacturer.

F. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the contract requirements and meets the approval of the Engineer.

G. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.

H. Altitude: Equipment affected by altitude shall perform satisfactorily for the function intended at the altitude of the project site.

I. Compatibility: Provide products, which are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work.

J. Substitution: Manufacturer's catalog numbers are specified for the purpose of establishing a standard. All proposed substitutions on specific materials (lighting fixtures but not limited to) shall be submitted in duplicate ten (10) days prior to bid openings. This request shall be accompanied by complete descriptions of the substitutes offered, including catalog cut sheets, performance, quality and dimensions. The entire burden of proof of equality shall be placed on the Electrical Subcontractor and the decision of the Engineer shall be final. All other electrical equipment, devices, etc. may have substitutions only if equal in quality and function to, or better than, the specified item. Complete descriptive and technical data shall be submitted on all proposed substitute items, together with the same data on the specified items. Material samples of the proposed substitute item, together with samples of the specified items, shall be submitted for comparison and test when requested by the Engineer.

K. Work Quality: Fabrication, erection and installation of the complete electrical system shall be done in a first class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Electrical Subcontractor shall check all areas and surfaces where electrical equipment material is to be installed, removed or relocated and report any unsatisfactory conditions to the Engineer before starting work. Commencement of work signifies this Electrical Subcontractor's acceptance of existing conditions. In the acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of the workmen.

2.2. ELECTRICAL EQUIPMENT AND WIRING FOR AND MECHANICAL DIVISION

A. Responsibility

1. Unless otherwise indicated, all motors, conduit, wiring, and controls (including temperature) shall be furnished, set in place, and wired in accordance with the following schedule. (MD is Mechanical Division and ED is Electrical Division)

| **MECHANICAL-ELECTRICAL COORDINATION TABLE 1** | | | |
|---|---|---|---|
| ITEM | FURNISHED UNDER | SET IN PLACE OR MOUNTED UNDER | WIRED AND CONNECTED UNDER |

| | | | |
|---|---|---|---|
| 1. Equipment Motors and Thermal Overloads | MD | MD | ED |
| 2. Motor Controllers(HOA): magnetic starters, and overload relays | MD (1) | ED (1) | ED |
| 3. Disconnect switches, fused or unfused, variable frequency drive (VFD) controllers (HOA), thermal overload switches and fuses, | ED (1) | ED (1) | ED |
| 4. Pushbutton stations(HOA), float switches, thermostats, control relays, motor valves, and interlocks | MD | MD (2) | MD (2) |
| 5. Contactors, 120V control circuit outlets for control panels and for boiler controls | ED | ED | ED |

Notes:

1. If furnished as part of factory wired equipment, wiring, conduit, and connection only by ED
2. If float switches, etc., carry the FULL LOAD CURRENT of any motor, they shall be furnished by the Mechanical Division, but shall be set in place, wired and connected by the Electrical Division, except that where such items are an integral part of the mechanical equipment, they shall be set in place under the Mechanical Division and wired and connected by the Electrical Division. If they do not carry the FULL LOAD CURRENT to any motor they shall be furnished, set in place and wired under the Mechanical Division.
3. Wiring and conduit from alarm contacts to alarm system and conduit for control functions by ED; set in place and all control function wiring by MD.
4. Mechanical division to set in place, Mechanical Contractor to make mechanical connections and Electrical Contractor to make electrical connections.

L. Connections

1. Connection to all control directly attached to ducts, piping and mechanical equipment shall be made with flexible connections not to exceed 3 linear feet.

2.3. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The

Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

PART 3 – EXECUTION

3.1. GENERAL REQUIREMENTS:

A. Comply with manufacturer's recommended installation procedures for electrical equipment. Refer to specific Division 26 specification sections for specific equipment installation requirements.

3.2. ELECTRICAL INSTALLATION

A. Install all work to permit removal (without damage to other parts) of breakers and all other parts, which might require periodic replacement or maintenance. Arrange conduit and equipment to permit ready access to panels and to clear opens of doors and of access panels.

B. Electrical Contractor shall coordinate with other trade with regards to equipment going under mechanical equipment.

C. Electrical Contractor shall install electrical equipment in a manner to provide the manufacturer's recommended service clearance and access space. The Electrical Contractor shall be responsible for maintaining these clearances, coordinating them with the other trades and have installed work modified to maintain these clearances at no additional charge to the project or the Owner.

3.3. PROTECTION OF PENETRATION

A. All penetrations of fire or smoke barriers shall be sealed, sleeves (if any), insulation (if any), and vibration isolation (if any) that maintain the fire or smoke resistance of the barrier in accordance with the latest edition of NFPA 101 Life Safety Code.

B. Contractor shall verify locations and type of all partitions penetrations from the drawings. Sealing material and methods shall be per UL recommendations. The Contractor shall fire stop all penetrations through fire and smoke rated barriers as required by code. Refer to Division 7 for fire stopping material information.

3.4. ELECTRICAL WORK CLOSEOUT:

A. General: Refer to the Division 1 sections for general closeout requirements. Upon completion of the work, the various systems operated under load conditions shall be tested for short circuits and grounds in accordance with the method and

resistance values outlined in the National Electrical Code and for load balance on feeders and branch circuits.

B. The complete system shall operate satisfactorily in every respect. Make any repairs or adjustments necessary to this end to the satisfaction of the Engineer.

C. Furnish all instruments and labor for testing.

3.5. GUARANTEE:

A. The work to be performed shall be guaranteed for a period of one year after final acceptance against faulty workmanship and/or materials, and any failure or trouble due to such causes within the period of guarantee shall be made good upon demand of the Owner and without cost to the Owner.

3.6. MISCELLANEOUS ITEMS:

A. Miscellaneous items not covered in these specifications shall be as indicated on the drawings, installed and connected by the proper method and as recommended by the manufacturer.

B. Coordinate the thickness of the wall to accommodate the concealed conduits and its associated hangers, if required. I.E. 4-inch conduit requires a 6-inch thick wall.

3.7. PRODUCT HANDLING:

A. Use all means necessary to protect electrical materials and equipment before, during and after installation and to protect the installed work of other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no extra cost to him.

3.8. AS-BUILT DRAWINGS:

A. During progress of the Work, maintain an accurate record of the installation of the system. Upon completion of the installation, transfer all record data to blue line prints of the original drawings and furnish to the Engineer.

END OF SECTION 26 05 00

# SECTION 26 05 10 – BASIC ELECTRICAL MATERIALS AND METHODS

## PART 1 – GENERAL

### 1.01. SUMMARY

A. Section includes grounding electrodes and conductors; equipment grounding conductors; bonding methods and materials; conduit and equipment supports; anchors and fasteners; nameplates and labels; wire markers; raceway markers; and underground warning tape.

B. Section includes sealing and fireproofing of sleeves/openings between conduits, cable trays, wireways, troughs, cable bus, busduct, etc. and the structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

### 1.02. REFERENCES

A. NECA (National Electrical Contractors Association) – Standard of Installation.

B. NETA ATS (International Electrical Testing Association) – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NFPA 99 (National Fire Protection Association) – Health Care Facilities.

### 1.03. SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Existing Metal underground water pipe.
2. Concrete-encased electrode.
3. Rod electrode.

B. Electrical products are anchored and fastened to building elements and finishes as follows:

1. Concrete Structural Elements: Use precast inserts and expansion anchors.
2. Steel Structural Elements: Use beam clamps.
3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.

5. Solid Masonry Walls: Use expansion anchors.
6. Sheet Metal: Use sheet metal screws.
7. Wood Elements: Use wood screws.

C. Electrical components are identified as follows:

1. Nameplate for each electrical distribution and control equipment enclosure.

1.04. DESIGN REQUIREMENTS

A. Select materials, sizes, and types of anchors, fasteners, and supports to carry the loads of equipment and raceway, including weight of wire and cable in raceway.

1.05. PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

1.06. SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit grounding electrodes and connections; for fastening components; and nameplates, labels, and markers.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Manufacturer's Installation Instructions: Submit for active electrodes.

1.07. CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of components and grounding electrodes

1.08. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.09. FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 – PRODUCTS

2.01. ROD ELECTRODES

A. Manufacturers:

1. Cadweld
2. Erico
3. Substitutions: Section 01 60 00 – Product Requirements

B. Material: Copper-clad steel.

C. Diameter: 3/4 inch

D. Length: 10 feet

2.02. WIRE

A. Material: Stranded or solid copper per drawing.

B. Grounding Electrode Conductor.

2.03. ANCHORS AND FASTENERS

A. Materials and Finishes: Corrosion resistant.

2.04. FORMED STEEL CHANNEL

A. Description: Galvanized steel.

2.05. SPRING STEEL CLIPS

A. Manufacturers:

2.06. NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

B. Letter Size:

1. 1/2-inch letters for identifying panels and ATSs.

## 2.07. SEALING AND FIREPROOFING

A. Fire and/or Smoke rated Surfaces:

1. 3M CP 25N/S or CP25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. series F fire barrier kits, Proset systems fire rated floor and wall penetrations, Insta-Foam Products Insta-Fire seal Firestop Foam, Dow Corning Fire Stop System, or an approved equal.
2. All products must be UL listed or tested by an independent testing laboratory. Use a product that has a rating not less than the rating of the wall or floor being penetrated.

B. Non-Rated Surfaces:

1. Use stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied areas where conduit is exposed.
2. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the cored opening or a water-stop type wall sleeve.
3. At interior wall or floor openings use Tremco Dymonic, Sika Corp. Sikaflex Ia, Sonneborn Sonolastic NPI, or Mameco Vilken 116 urethane caulk or approved equal to effect the seal.

# PART 3 – EXECUTION

## 3.01. EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify final backfill and compaction has been completed before driving rod electrodes.

C. Verify that abandoned wiring and equipment serve only abandoned facilities.

## 3.02. EXISTING WORK

A. Demolition Drawings are based on casual field observation. Report discrepancies to Engineer before disturbing existing installation.

B. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

C. Provide temporary wiring and connections to maintain existing systems in service during construction.

D. When work must be performed on energized equipment or circuits, use personnel experienced and trained in such operations.

E. Remove, relocate, and extend existing installations to accommodate new construction.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors. Patch surfaces damaged by removal of existing components.

3.03. INSTALLATION

A. Grounding and Bonding Installation:

1. Install rod electrodes at locations indicated.
2. Install 4 AWG bare copper wire where indicated.

B. Identification Components:

1. Degrease and clean surfaces to receive nameplates and labels.
2. Install nameplate parallel to equipment lines.
3. Secure nameplate to equipment front using adhesive.
4. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

C. Fire Rated Surface:

1. When the opening is through a fire rated wall, floor, ceiling or roof the opening must be sealed by installing a steel sleeve, minimum 12ga., through the opening and extending beyond a minimum of 1 inch. Further, the sleeve shall be large enough to allow a minimum of a 1 inch void between the sleeve and the item of penetration. The void shall be packed with an approved backing material and the ends of the sleeve sealed with a minimum of 1 inch of a listed fire-resistive

silicone compound to a depth required to meet the fire rating of the structure penetrated.

2. Install approved product in accordance with the manufacturer's instructions where a cable tray, bus, cable bus, conduit, wireway, trough, etc. penetrates a fire rated surface.

D. Non-Rated Surfaces:

1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approve type of material.
2. Use galvanized sheet metal sleeves in hollow wall penetrations to provide a backing for the sealant. Grout area around sleeve in masonry construction.
3. Install escutcheons or floor/ceiling plates where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.
4. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with the manufacturer's instructions.
5. At interior partitions, pipe penetrations are required to be sealed for all clean rooms, laboratories, most hospital spaces, computer rooms, tele/data/com rooms and similar spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve and the pipe is completely filled.

END OF SECTION 26 05 10

# SECTION 26 05 11 – MINOR ELECTRICAL DEMOLITION FOR REMODELING

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Electrical demolition.

### 1.2. RELATED SECTIONS

A. Section 01 35 16 - Alteration Project Procedures.

B. Section 02 41 00 - Minor Demolition for Remodeling.

## PART 2 – PRODUCTS

### 2.1. MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

## PART 3 – EXECUTION

### 3.1. EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation. Report discrepancies to Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

### 3.2. PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Utility Company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.

3.3. DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Section 01 35 16, Section 02 41 00, and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations.

3.4. CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaries for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.5. INSTALLATION

A. Install relocated materials and equipment under the provisions of Section 01 35 16.

END OF SECTION 26 05 11

# SECTION 26 05 19 – BUILDING WIRE AND CABLE

## PART 1 – GENERAL

### 1.1. SUMMARY

A. Section includes building wire and cable and wiring connectors and connections.

### 1.2. REFERENCES

A. NECA (National Electrical Contractors Association) – Standard of Installation.

B. NETA ATS (International Electrical Testing Association) – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

### 1.3. WIRING METHODS AND PRODUCTS REQUIREMENTS

A. Product Requirements: Use products as indicated and as follows:

1. Use solid conductor for feeders and branch circuits 12 AWG and smaller.
2. Use conductor not smaller than 12 AWG for power and lighting circuits.
3. Use conductors for 80% of branch circuits circuit breaker size to provide no more than 3% voltage drop on branch circuits and no more than 5% voltage drop total from service entrance point to the load.

B. Wiring Methods: Use wiring methods indicated and as follows:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN, insulation in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation in raceway.

### 1.4. FIELD MEASUREMENTS

A. Verify field measurements are as indicated

### 1.5. COORDINATION

A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.

## PART 2 – PRODUCTS

### 2.1. BUILDING WIRE

A. Manufacturers:

1. Houston Wire and Cable
2. Southwire
3. Substitutions: Section 01 60 00 – Product Requirements – Permitted

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation: Thermoplastic material rated 75 degrees C.

2.2. WIRING CONNECTORS

A. Split Bolt Connectors:

1. Ilsco
2. Substitutions: Section 01 60 00 – Product Requirements – Permitted.

B. Solderless Pressure Connectors:

1. Ilsco
2. Substitutions: Section 01 60 00 – Product Requirements – Permitted.

C. Spring Wire Connectors:

1. Ilsco
2. Substitutions: Section 01 60 00 – Product Requirements – Permitted.

D. Compression Connectors:

1. Ilsco
2. Substitutions: Section 01 60 00 – Product Requirements – Permitted.

PART 3 – EXECUTION

3.1. EXAMINATION

A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2. EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes if wire and cable servicing them is abandoned and removed. Provide blank cover for abandoned boxes, which are not removed.

C. Ensure access to existing wiring connections which remain active and which require access. Modify installation or provide access panel as appropriate.

D. Extend existing circuits using materials and methods compatible with existing electrical installations or as specified.

3.3. INSTALLATION

A. Route wire and cable as required to meet Project conditions.

B. Install wire and cable in accordance with the NECA “Standard of Installation.”

C. Neatly train and lace wiring inside boxes, equipment and panelboards.

3.4. FIELD QUALITY CONTROL:

A. Section 01 40 00 – Quality Requirements: Testing and inspection services.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspection and tests listed in NEAT ATS, Section 7.3.1

END OF SECTION 26 05 19

# SECTION 26 05 26 – GROUNDING AND BONDING

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Equipment grounding conductors.

B. Bonding.

### 1.2. REFERENCES

A. Section 01 45 00 – Quality Control: Requirements for references and standards.

B. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).

C. NFPA 70 – National Electrical Code.

### 1.3. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

C. Conforms to requirements of NFPA 99.

## PART 2 – PRODUCTS

### 2.1. EQUIPMENT GROUNDING CONDUCTOR

A. Material: Stranded copper.

B. Size to meet NFPA 70 requirements.

## PART 3 – EXECUTION

### 3.1. EXAMINATION

A. Section 01 31 00 – Coordination and Meetings: Verification of existing conditions prior to beginning work.

### 3.2. INSTALLATION

A. Section 01 45 00 – Quality Control: Manufacturer's instructions.

B. Provide bonding to meet Regulatory Requirements.

C. Bond together each metallic raceway, pipe, duct and other metal objects.

D. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.3. FIELD QUALITY CONTROL

A. Section 01 43 00 – Quality Assurance: Field inspection, testing and adjusting.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform Inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION 26 05 26

# SECTION 26 05 29 – SUPPORTING DEVICES

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

### 1.2. REFERENCES

A. Section 01 45 00 – Quality Control: Requirements for references and standards.

B. NECA Standard of Installation (National Electrical Contractors Association).

C. NFPA 70 – National Electrical Code.

### 1.3. SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Product Data: Provide manufacturers catalog data for fastening systems.

### 1.4. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

## PART 2 – PRODUCTS

### 2.1. PRODUCT REQUIREMENTS

A. Materials and Finishes: Corrosion resistant.

B. Select materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit, including weight of wire in conduit.

C. Anchors and Fasteners:

1. Concrete Structural Elements: Use pre-cast inserts, expansion anchors and preset inserts.
2. Steel Structural Elements: Use beam clamps and welded fasteners.
3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.

4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
5. Solid Masonry Walls: Use expansion anchors.
6. Sheet Metal: Use sheet metal screws.

2.2. FORMED STEEL CHANNEL

A. Manufacturers:

1. B-line.
2. Unistrut.
3. Substitutions: Refer to Section 01 60 00 – Material and Equipment.

B. Description: Galvanized or Painted steel.

PART 3 – EXECUTION

3.1. INSTALLATION

A. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
2. Do not drill or cut structural members.

B. Fabricate supports from structural steel or formed steel members. Rigidly weld members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

C. Install surface-mounted cabinets and panelboards with minimum of four anchors.

D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.

E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 26 05 29

# SECTION 26 05 33 – CONDUIT

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Metal conduit.

B. Flexible metal conduit.

C. Liquid tight flexible metal conduit.

D. Electrical metallic tubing.

E. Nonmetal conduit.

F. Fittings and conduit bodies.

### 1.2. RELATED SECTIONS

A. Section 07 84 00 - Fire Stopping.

B. Section 26 05 43 - Underground Duct Bank.

C. Section 26 05 34 - Boxes.

D. Section 26 05 26 - Grounding and Bonding.

E. Section 26 05 29 - Supporting Devices.

F. Section 26 05 53 - Electrical Identification.

### 1.3. REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

D. ANSI/NFPA 70 - National Electrical Code.

E. NECA "Standard of Installation."

F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4. DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.5. SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide for metallic conduit, flexible metal conduit, liquid tight flexible metal conduit, metallic tubing, nonmetallic conduit and conduit bodies.

1.6. PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 78 39.

1.7. REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.9. PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 – PRODUCTS

2.1. CONDUIT REQUIREMENTS

A. Minimum Size: 3/4 inch unless otherwise specified.

B. Underground Installations:

1. More than Five Feet from Foundation Wall: use rigid steel conduit or plastic coated conduit
2. Within Five Feet from Foundation Wall: Use rigid steel conduit.
3. In or Under Slab on Grade: Use rigid steel conduit or plastic coated conduit.
4. Minimum Size: 3/4 inch.

C. Outdoor Locations, Above Grade: Use rigid steel conduit.

D. In Slab Above Grade:

1. Use rigid steel conduit or thickwall nonmetallic conduit.
2. Maximum Size Conduit in Slab: 1/2 inch.

E. Wet and Damp Locations: Use rigid steel conduit.

F. Dry Locations:

1. Concealed: Use rigid steel conduit and electrical metallic tubing.
2. Exposed: Use rigid steel conduit and electrical metallic tubing.

2.2. METAL CONDUIT

A. Manufacturers:

1. Allied.
2. Substitutions: Under provisions of Section 26 05 00.

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

2.3. FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Alflex.
2. Greenfield.
3. Substitutions: Under provisions of Section 26 05 00.

B. Description: Interlocked steel construction.

C. Fittings: ANSI/NEMA FB 1.

2.4. LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Ultratight.
2. Substitutions: Under provisions of Section 01 60 00.

B. Description: Interlocked steel construction with PVC jacket.

C. Fittings: ANSI/NEMA FB 1.

2.5. ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied.
2. Substitutions: Under provisions of Section 01 60 00.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, compression type.

2.6. NONMETALLIC CONDUIT

A. Manufacturers:

1. Carlon.
2. Cantex.
3. Substitutions: Under provisions of Section 01 60 00.

B. Description: NEMA TC 2; Schedule 40 and 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 – EXECUTION

3.1. INSTALLATION

A. Install conduit in accordance with NECA "Standard of Installation."

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

C. Arrange supports to prevent misalignment during wiring installation.

D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

F. Fasten conduit supports to building structure and surfaces under provisions of Section 16190.

G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports

H. Do not attach conduit to ceiling support wires.

I. Arrange conduit to maintain headroom and present neat appearance.

J. Route exposed conduit parallel and perpendicular to walls.

K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

L. Route conduit in and under slab from point-to-point.

M. Do not cross conduits in slab.

N. Maintain adequate clearance between conduit and piping.

O. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding $40^{O}C$.

P. Cut conduit square using saw or pipe-cutter; de-burr cut ends.

Q. Bring conduit to shoulder of fittings; fasten securely.

R. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

S. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

T. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch size.

U. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

V. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.

W. Provide suitable pull string in each empty conduit except sleeves and nipples.

X. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

Y. Ground and bond conduit under provisions of Section 26 05 26.

Z. Identify conduit under provisions of Section 16195.

3.2. INTERFACE WITH OTHER PRODUCTS:

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07 27 00.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.

END OF SECTION 26 05 33

# SECTION 26 05 34 – BOXES

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Pull and junction boxes.

### 1.2. RELATED SECTIONS

A. Section 07 84 00 - Firestopping.

B. Section 08 31 13 - Access Doors.

C. Section 26 27 26 - Wiring Devices: Wall plates in finished areas.

D. Section 26 27 16 - Cabinets and Enclosures.

### 1.3. REFERENCES

A. NECA – Standard of Installation.

B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA 70 – National Electrical Code.

### 1.4. SUBMITTALS FOR CLOSEOUT

A. Section 01 70 00 – Contract Closeout: Submittals for Project closeout.

B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

### 1.5. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Provide Products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

## PART 2 – PRODUCTS

### 2.1. OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2-inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

B. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: As specified in Section 26 27 26.

### 2.2. PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

C. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:

1. Material: Galvanized cast iron.
2. Cover: Smooth cover with neoprene gasket and stainless-steel coverscrews.
3. Cover Legend: "ELECTRIC".

## PART 3 – EXECUTION

### 3.1. EXAMINATION

A. Verify locations of outlets in offices and work areas prior to rough-in.

### 3.2. INSTALLATION

A. Install boxes in accordance with NECA "Standard of Installation."

B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose.

E. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

F. Maintain headroom and present neat mechanical appearance.

G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

I. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 27 00.

J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

L. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

M. Use flush mounting outlet box in finished areas.

N. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

O. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

P. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

Q. Use stamped steel bridges to fasten flush mounting outlet box between studs.

R. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

S. Use adjustable steel channel fasteners for hung ceiling outlet box.

T. Do not fasten boxes to ceiling support wires.

U. Support boxes independently of conduit.

V. Use gang box where more than one device is mounted together. Do not use sectional box.

W. Use gang box with plaster ring for single device outlets.

X. Use cast outlet box in exterior locations exposed to the weather and wet locations.

Y. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

Z. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3. INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for equipment connected under other sections.

3.4. ADJUSTING

A. Section 01 70 00 – Contract Closeout: Adjusting installed work.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.5. CLEANING

A. Section 01 70 00 – Contract Closeout: Cleaning installed work.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION 26 05 34

# SECTION 26 05 53 – ELECTRICAL IDENTIFICATION

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers.

### 1.2. RELATED SECTIONS

A. Section 09 91 00 – Painting.

### 1.3. REFERENCES

A. Section 01 45 00 – Quality Control: Requirements for references and standards.

B. NFPA 70 – National Electrical Code.

### 1.4. SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

### 1.5. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

## PART 2 – PRODUCTS

### 2.1. NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, white letters on black background.

B. Locations:

1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.

C. Letter Size:

1. 1/8-inch letters for identifying individual equipment and loads.
2. 1/4-inch letters for identifying grouped equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches and receptacles and control device stations.

2.2. WIRE MARKERS

A. Manufacturers:

1. Brady
2. Panduit
3. Substitutions: Refer to Section 01 60 00 – Material and Equipment.

2.3. UNDERGROUND WARNING TAPE

A. Description: 4-inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

B. Location: Along length of each underground conduit.

PART 3 – EXECUTION

3.1. PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2. INSTALLATION

A. Section 01 45 00 – Quality Control: Manufacturer's instructions.

B. Install nameplate and label parallel to equipment lines.

C. Secure nameplate to equipment front using rivets.

D. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

E. Identify underground conduits using one underground warning tape per trench at 3 inches below finished grade.

END OF SECTION 26 05 53

# SECTION 26 05 63 – EQUIPMENT WIRING SYSTEMS

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Electrical connections to equipment specified under other sections.

### 1.2. RELATED SECTIONS

A. Section 01 11 00 - Summary of Work: Owner-furnished equipment.

B. Section 22 10 00 - Plumbing Equipment.

C. Section 26 05 33 - Conduit.

D. Section 26 05 19 - Building Wire and Cable.

E. Section 26 05 34 - Boxes.

### 1.3. REFERENCES

A. NEMA WD 1 - General Purpose Wiring Devices.

B. NEMA WD 6 - Wiring Device Configurations.

C. ANSI/NFPA 70 - National Electrical Code.

### 1.4. SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

### 1.5. REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.6. COORDINATION

A. Coordinate work under provisions of Section 01 31 00.

B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

E. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 – PRODUCTS

2.1. CORDS AND CAPS

A. Attachment Plug Construction: Conform to NEMA WD 1.

B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

C. Cord Construction: ANSI/NFPA 70, Type SO or SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over current protection.

PART 3 – EXECUTION

3.1. EXAMINATION

A. Verify conditions under provisions of Section 02 21 00.

B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2. ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

E. Install disconnect switches, controllers, control stations, and control devices as indicated.

F. Modify equipment control wiring with terminal block jumpers as indicated.

G. Provide interconnecting conduit and wiring between devices and equipment where indicated.

END OF SECTION 26 05 63

# SECTION 26 24 16 – PANELBOARDS

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Distribution panelboards.

B. Branch circuit panelboards.

### 1.2. RELATED SECTIONS

A. Section 26 05 26 – Grounding and Bonding.

B. Section 26 05 53 – Electrical Identification.

### 1.3. REFERENCES

A. NECA Standard of Installation (published by the National Electrical Contractors Association).

B. NEMA AB1 - Molded Case Circuit Breakers.

C. NEMA ICS 2 – Industrial Control Devices, Controllers and Assemblies.

D. NEMA KS1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

E. NEMA PB 1 – Panelboards.

F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

G. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

H. NFPA 70 – National Electrical Code.

### 1.4. SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes. Indicate service maintenance and access clearances.

1.5. SUBMITTALS FOR CLOSEOUT

A. Section 01 70 00 – Contract Closeout: Submittals for project closeout.

B. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

1.7. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.8. MAINTENANCE MATERIALS

A. Section 01 70 00 – Contract Closeout.

B. Furnish two of each panelboard key.

PART 2 – PRODUCTS

2.1. DISTRIBUTION PANELBOARDS

A. Section 01 60 00 – Material and Equipment: Product Options and Substitutions.

B. Manufacturers:

1. Square-D.
2. Westinghouse.
3. General Electric.
4. Substitutions: Permitted.

C. Description: NEMA PB 1, circuit breaker type.

D. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

E. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt panelboards, or as indicated.

F. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

G. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

H. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

I. Enclosure: NEMA PB 1, Type 1.

J. Cabinet Front: Surface type, fastened with concealed screws, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.2. BRANCH CIRCUIT PANELBOARDS

A. Section 01 60 00 – Material and Equipment: Product Options and Substitutions.

B. Manufacturers:

1. General Electric.
2. Square-D.
3. Westinghouse.
4. Substitutions: Permitted.

C. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

D. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A

ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1.

H. Cabinet Box: 6 inches deep, 20 inches wide.

I. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 – EXECUTION

3.1. INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."

B. Install equipment with and maintain all service clearances as required by code and/or recommended by the manufacturer.

C. Install panelboards plumb.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Provide filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

G. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

H. Ground and bond panelboard enclosure according to Section 26 05 26.

3.2. FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control: Field inspection, testing and adjusting.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

3.3. ADJUSTING

A. Section 01 70 00 – Contract Closeout: Adjusting installed work.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 26 24 16

# SECTION 26 27 16 – CABINETS AND ENCLOSURES

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Hinged cover enclosures.

B. Cabinets.

C. Terminal blocks.

D. Accessories.

### 1.2. RELATED SECTIONS

A. Section 26 05 29 – Supporting Devices.

### 1.3. REFERENCES

A. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NEMA ICS 4 – Terminal Blocks for Industrial Control Equipment and Systems.

C. ANSI/NFPA 70 – National Electrical Code.

### 1.4. SUBMITTALS

A. Submit under provisions of Section [01 33 00.]

B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

### 1.5. REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc.as suitable for purpose specified and shown.

### 1.6. EXTRA MATERIALS

A. Provide two of each cabinet key.

PART 2 – PRODUCTS

2.1. HINGED COVER ENCLOSURES

A. Construction: NEMA 250, Type 3R steel enclosure.

B. Covers: Continuous hinge, held closed by flush latch operable by key.

2.2. CABINETS

A. Boxes: Galvanized steel.

B. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.

C. Provide accessory feet for free-standing equipment.

PART 3 – EXECUTION

3.1. EXAMINATION

A. Verify that surfaces are ready to receive Work.

3.2. INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

C. Install cabinet fronts plumb.

END OF SECTION 26 27 16

# SECTION 26 27 26 – WIRING DEVICES

## PART 1 – GENERAL

### 1.1. SUMMARY

A. Related Sections:

1. Section 26 05 34 – Raceway and Boxes: Outlet boxes for wiring devices.

### 1.2. REFERENCES

A. NECA (National Contractors Association) – Standard of Installation.

B. NEMA WD 1(National Electrical Manufacturers Association) – General Requirements for Wiring Devices.

C. NEMA WD 6 (National Electrical Manufacturers Association) – Wiring Device – Dimensional Requirements.

## PART 2 – PRODUCTS

### 2.1. WALL SWITCHES

A. Manufacturers:

1. Hubbell
2. Pass and Seymour

B. Single Pole Switch: Non-Emergency

1. Hubbell 1221-I
2. Pass and Seymour 20AC1-I

C. Single Pole Switch: Emergency

1. Hubbell 1221-RED
2. Pass and Seymour 20AC1-RED

D. Ratings: Match branch circuit and load characteristics.

### 2.2. RECEPTACLES

A. Receptacle: Non-Emergency

1. Hubbell

2. Pass and Seymour.

2.3. WALL PLATES

A. Manufacturers:

1. Pass and Seymour
2. Hubbell

B. Decorative Cover Plate: Match existing

PART 3 – EXECUTION

3.1. EXAMINATION

A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that branch circuit wiring installation is completed, tested and ready for connection to wiring devices.

3.2. PREPARATION

A. Clean debris from outlet boxes.

3.3. EXISTING WORK

A. Disconnect abandoned wiring devices and remove them.

B. Ensure access to existing wiring devices which remain active. Modify installation as appropriate.

C. Clean and repair existing wiring devices which remain or are to be reinstalled.

3.4. INSTALLATION

A. Install in accordance with NECA “Standard of Installation.”

3.5. ADJUSTING

A. Section 01 70 00 – Execution Requirements: Testing, Adjusting and Balancing.

B. Adjust devices and wall plates to be flush and level.

3.6. CLEANING

A. Section 01 45 00 – Execution Requirements: Final Cleaning

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

# SECTION 26 28 19 – ENCLOSED SWITCHES

## PART 1 – GENERAL

### 1.1. SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

C. Fuses.

### 1.2. REFERENCES

A. NEMA KS 1 – Enclosed Switches.

B. NFPA 70 – National Electrical Code.

C. UL 198C – High-Interrupting Capacity Fuses; Current Limiting Type.

D. UL 198E – Class R Fuses.

### 1.3. SUBMITTALS

A. Submit under provisions of Section 01 33 00 and 26 05 00.

B. Product Data: Provide switch ratings and enclosure dimensions.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

### 1.4. QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

B. Maintain one copy of each document on site.

### 1.5. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

### 1.6. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.7. EXTRA MATERIALS

A. Furnish under provisions of Section 01 70 00 and 26 05 00.

B. Provide three of each size and type fuse installed.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. General Electric (GE).

B. Square D.

C. Siemens.

D. Cuttler Hammer.

E. Substitutions: Refer to Sections 01 60 00 – Materials and Equipment and 26 05 00 – General Electrical Requirements: For Product options and substitutions.

2.2. ENCLOSED SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R or J fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

2.3. FUSES

A. Manufacturers:

1. Bussman.
2. Little Fuse.
3. Gould Schmaut.
4. Substitutions: Refer to Sections 01 60 00 – Materials and Equipment and 26 05 00 – General Electrical Requirements: For Product options and substitutions

B. Description: Per Drawings – rated for voltage of equipment.

C. Interrupting Rating: 200,000 rms amperes.

PART 3 – EXECUTION

3.1. INSTALLATION

A. Install disconnect switches where indicated.

B. Install fuses in fusible disconnect switches.

C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION 26 28 19

# SECTION 26 29 23 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:

A. Section 22 05 00 – Basic Mechanical Requirements

B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors

C. Section 23 05 53 – Mechanical Identification

1.01 RELATED SECTIONS

A. Section 23 05 13 - Motors

C. Section 23 09 23 – Energy Management Control System

D. Section 23 21 23 - HVAC Pumps

I Section 26 05 19 - Cable, Wire and Connectors, 600 Volt

1.02 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings

C. AMCA 99 - Standards Handbook

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices

G. NEMA MG1 - Motors and Generators

H. NFPA 70 - National Electrical Code

I. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems

J. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies

K. IEEE std 519 – Guide for Harmonic Control and Reactive Compensation of Static Power Converters

L. IEEE – std 112B and 587

## 1.03 SUBMITTALS

A. Submit under provisions of Section 22 00 00.

B. Shop Drawings:

1. Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

2. Provide terminal block to terminal block wiring diagrams coordinated with the Owner to provide a complete and functional system.

3. Provide circuit board wiring diagrams and passive part generic specifications suitable to allow for circuit board service and repair by the Owner.

4. Provide detailed drawings showing construction, dimensions, wiring diagrams, and installation procedures for Engineer’s approval.

C. Product Data:

1. Provide product data on variable frequency drives, relays, pilot devices, and switching and over-current protective devices. Specifically indicate which options are included.

2. Provide literature that indicates dimensions, weights, capacities, ratings, performance, gauges and finishes of materials, and electrical characteristics and connection requirements.

3. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.

D. Manufacturer's Installation Instructions

E. Where not otherwise specified, provide a minimum of 6 submittals, plus the number the contractor wants returned.

## 1.04 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 00 00.

B. Submit one (1) sets of O&M manuals, bound in 3-ring binders and indexed and tabbed for ease of use, containing, as a minimum, operation and

maintenance data, trouble-shooting guide, and all approved submittal data, including wiring diagrams and one set on CD.

C. Include instructions for routine service and recommended maintenance procedures and intervals.

D. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, who issues complete catalog data on total product.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 26 05 00.

B. Packaging: The drive must be delivered as a fully assembled, single unit ready for installation. It must be packaged in a manner suitable for anticipated shipping and storage conditions.

C. Accept products on site in factory fabricated protective containers, with factory installed shipping skids and lifting lugs. Inspect for damage.

D. Storage and Handling: The manufacturer shall inform the Contractor and the Owner of any special storage or handling requirement that may be required. Storage shall be indoors, in a clean dry place and protected from weather and construction traffic. Units shall be wrapped at the factory for protection from dirt, water, construction debris, and traffic. Protective wrapping shall be removed from the unit prior to start-up and shall be replaced and sealed by the Contractor until which time the unit is put into regular service. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 SERVICE AND SPARE PARTS

A. The manufacturer's representative shall provide a list of recommended spare parts.

B. Fuses: Furnish, to Owner, three sets of spare fuses of each type and rating installed.

C. Drive parts and service shall be available on a local or regional (within 100 miles radius) basis to preclude lengthy periods of operation in the uneconomical bypass mode.

1.08 WARRANTY AND GUARANTEE

A. Provide warranty under provision of Section 26 05 00.

B. Warranty shall be 36 months (3 Years) from the date of project substantial completion. Include all parts, labor, shipping, field service or technician time, labor or travel expenses, and expenses. In no case shall a charge be made to the Owner for VFD failures, other than those caused by flagrant abuse or extraordinary circumstances, such as water damage due to flooding or pipe break. Provide documentation of verbal and written correspondence with the VFD manufacturer or his representatives, including that which might be incidental to the proper installation and operation of the equipment.

C. The representative shall maintain local factory certified technicians for 24 hour, 7-day a week service. Throughout the warranty service period, response shall be within 24 hours of initial contact for service.

D. The manufacturer shall guarantee spare parts availability to the Owner for a minimum of fifteen (15) years from date of purchase. Price escalation for spare parts shall not exceed 10% per year over the fifteen (15) year duration.

1.12 SCHEDULES ON DRAWINGS:

A. In general, all capacities of equipment and electrical characteristics are shown in schedules on the Drawings. Reference shall be made to the schedules for such information. The capacities shown are minimum capacities. Variations in the capacities of the scheduled equipment supplied under this contract will be permitted only with the written direction of the owner. Where installation instructions are not included in these Specifications or on the Drawings, the manufacturer's instructions shall be followed.

## PART 2 PRODUCTS

2.01. MANUFACTURERS

A. ABB (model ACH 550)

B. Danfoss (model VLT FC100)

C. Substitutions: Use provisions of Section 26 05 00. The equipment as supplied by any of the acceptable manufacturers or an approved equal shall

comply with all of the provisions of this specification. Any substitutions for manufacturers or model numbers must be approved by the campus maintenance group.

## 2.02 GENERAL

A. Furnish and install complete solid state variable frequency drive, with Pulse Width Modulation (PWM) output waveform, including a full wave rectifier to prevent input line notching, AC line reactor, input fuses, capacitors, and insulated bipolar gate transistors (IBGT) as the output switching device. SCR, GTO and Darlington transistors are not acceptable. Six step and current source are not acceptable. All standard and optional features shall be included within the VFD enclosure. VFD shall be approved by the equipment manufacturer for the particular product and application involved. All of the variable speed controllers shall be supplied by one manufacturer for this project. All safety devices shall be energized. If an equal is proposed and accepted, Contractor must include installation and start-up by manufacturer's authorized personnel.

B. The Contractor shall furnish and install Variable Frequency Drive (VFD) motor controllers to vary the speed of the supply, return and relief air fans and pumps as shown in the fan and pump schedules on the drawings. One controller shall control the speed of one motor only. See schedules and drawings for quantity of controllers required.

C. The Variable Frequency Drive shall produce an adjustable AC voltage and frequency output for complete motor control using solid-state technology. The VFD shall be automatically controlled by a grounded electronic (4-20 ma) control signal. The drive shall produce an output volts/Hertz pattern to produce adequate starting torque under all conditions and operate smoothly at all operating speeds on variable torque load. The VFD shall be self-contained totally enclosed in NEMA 1 ventilated cabinet and capable of operation between 0 degrees and 40 degrees Celsius.

D. VFD's shall be ETL or UL listed. All components used on option units shall be ETL or UL listed. VFD's shall be designed to meet IEEE-587 and shall comply with all applicable provisions of the latest revision of the National Electrical Code. The VFD shall comply with IEEE-519 with respect to the line noise generation.

E. The controllers shall be variable torque, variable voltage/frequency type for centrifugal fan and pump applications and suitable for use with both standard and high efficiency 3-phase, squirrel cage, induction motors.

F. The service factor of the controller shall be equal to 0.95 with a power unit rating basis of 100 percent rated current continuous. Rated continuous current of the VFD shall be equal to 110% of driven motor's FLA rating.

G. Each controller shall consist of a converter, D.C. link filter or supply power back-feed RF (radio frequency) filter, and an inverter section with each section modularized for ease of troubleshooting. The converter section shall convert fixed frequency and voltage AC utility power to a DC voltage. The inverter section shall invert the DC voltage into a quality output wave form, adjustable voltage and frequency output for stepless motor speed control. PWM controllers shall also have output line filters for motor noise reduction. All components shall be factory mounted and wired on a dead-front, grounded, freestanding or wall mounted minimum NEMA 1 enclosure arranged for top or bottom conduit entry.

H. The controller enclosure shall be provided with the manufacturer's illustrated operating instructions and parts list mounted inside the enclosure door, manual speed control potentiometer, three position mode selector switch ("hand- off - auto", or equivalent), "power on" light, auxiliary relays and contacts for interlock and control wiring.

I. The VFD and options shall be tested to ANSI/UL standard 508. The complete system shall be listed by a nationally recognized testing agency such as UL, ETH CUC or CSA.

J. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE 519-1992. Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFD. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.

## 2.03 FEATURES

A. Safety and Self-Protection Features

1. Input fused disconnect switch and thermal motor overloads

2. Input line filter capable of protecting the electronics against transient voltage spikes or notches, as well as back-feed of RF (Radio Frequency) interference, into the incoming power supply

3. Fuseless electronic power protection for ground fault protection. Isolation transformers for ground fault protection are not acceptable. Ground fault shall not cause fuses to open.

4. Current limiter capable of limiting output current to 110% of the inverter rating. Limiter shall function automatically to prevent over current trip on momentary overload.

5. Instantaneous over current trip at 315%

6. Inverse-time over current protection when current exceeds settings

7. The drive shall employ three current limit circuits to provide trip free operation:

   a. The slow current regulation limit circuit shall be adjustable to 125% (minimum) of the VFDs variable torque current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.

   b. The Rapid Current Regulation limit shall be adjustable to 170% (minimum) of the VFDs variable torque current rating.

   c. The Current Switch-off limit shall be fixed at 255% (minimum, instantaneous) of the VFDs variable torque current rating.

8. Under voltage trip at 65% of the VFD rated voltage

9. Over voltage trip at 130% of the VFD rated voltage. The VFD shall have nominal input voltage adjustments of 208-230 and 440-480 VAC.

10. Over temperature trip to protect the inverter from elevated temperatures in excess of component rating

11. The inverter logic shall be programmed to allow a trip condition resulting from power failure, power surge, over current, under current, over voltage, under voltage, or over temperature to automatically restart upon correction of the trip condition. The number of restart attempts shall be limited to five. If, after five attempts, the restart is not successful, the inverter shall shut down safely and require manual restart. If a successful restart occurs, the restart circuit counter will reset to zero counts after approximately ten minutes of uninterrupted operation.

12. Isolated operator controls for increased safety

13. Safe shutdown in the event of power loss and automatic return to normal operation and restart, without component damage, on resumption of power

14. Safe shutdown, without component damage, in phase-to-phase short circuit

15. Integral protection against damage due to input or output power contactor disconnect switch, or circuit breaker, being opened or closed while the control is activated

16. Protection against input transient voltage spikes

17. Protection against over voltage on the DC bus

18. Protection against output short circuit and motor winding shorting to case faults

19. Input line reactor to minimize harmonics reflected back onto the AC line and to provide improved protection to AC line transients

20. A door interlock, designed to cut power to the unit when the door is opened

21. Controller able to operate without a motor or other equipment load connected to the inverter output to facilitate start-up and troubleshooting

B. Operational Interface Features

1. The following door mounted devices:

a. "Power On" light to indicate that the VFD is being supplied line power

b. Fault light to indicate that the VFD has tripped on a fault condition

c. Pre-wired 3-position Hand/Off/Auto (or equivalent) selector switch, with means to communicate hand, off, or auto position

d. Manual speed potentiometer (1000 ohms)

e. Plain English, adjustable contrast backlit LCD digital display (code numbers and letters are not acceptable) and keypad. The digital display shall have 40 characters (2 line x 20 character/line). All set-up parameters, indications, faults, warnings, and other information must be displayed in words to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

f. Digital meter to indicate speed (percent of full speed and Hz indicated on readout) and percent load

g. Integral amp meter and volt meter, with provisions for readout at panel face

2. All VFDs shall have the same user interface, including digital display, keypad, and user connections regardless of horsepower rating. A keypad shall be used for local control, for setting all parameters, and for stepping through the displays and menus.

3. A set of form C, dry contacts (status contacts) to indicate when the VFD is running above 0% speed

4. A set of form C, dry contacts (fault contacts) to indicate when the VFD is in the fault mode

5. A 4-20 ma output signal to vary in direct linear proportion to the VFD output frequency

6. Provisions to isolate and allow VFD to operate from a 4-20mA, 0-10vdc, or 3-15psi pneumatic signal as needed now or in the future

7. Manual speed control during manual control mode

8. Dedicated terminal strip to allow interconnection of control circuits that accept normally closed safety contacts such as freeze stats, smoke alarms, fire alarms, interlocks, time clocks, energy management and building automation systems, and other input signals. VFD shall safely shut down in any mode when contact(s) opens. System shall be capable of such remote shutdown whether in the drive or bypass mode (if bypass is included in specific applications).

9. Output terminal for remote frequency and current meters (4 to 20 ma).

10. Trip relay for remote fault indication.

11. Internal self-diagnostics and fault detection shall be integral to each VFD. Diagnostics and fault detection shall be viewable from the digital display.

C. Bypass

1. An internal bypass is required for all applications except when redundant pumps or fans are included in the design and each piece of equipment has a dedicated VFD.

2. A thermally protected transfer switch for manual bypass of the VFD

3. A bypass switch that shall simultaneously isolate the VFD from input and output power, and provide line power directly to the motor. The bypass switch shall also have the capability of starting and stopping the motor. The switch shall consist of an enclosure separate from the VFD. The following shall be mounted on the enclosure door:

a. Door interlocked main input disconnect switch

b. Power on light

c. "Drive-off-bypass" manual mode selector switch

d. A "normal operation-off-test" selector to facilitate static testing of the drive at startup or while the motor is operating in the bypass mode

e. Speed lockout circuitry to allow the lockout or bypass of at least three speed ranges within the full range of the controller

4. Line, load and bypass contactors capable of interrupting the locked rotor rating of the driven motor. Bypass and load contactors must be mechanically interlocked to prevent simultaneous closure.

D. Adjustable Parameters

1. Maximum speed, adjustable 50-120% based speed
2. Minimum speed, adjustable 30-50% base speed
3. Acceleration time, adjustable 0.1 to 1800 seconds
4. Deceleration time, adjustable 0.1 to 1800 seconds
5. Current limit, adjustable 0-125%
6. Overload
7. Offset and gain to condition the input speed signal
8. 6-70 Hz controlled speed range (minimum to be set at 15 Hz)

E. Programmable Features

1. The VFD shall give the user the option of selecting either (1) displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last reference received, or (4) cause a warning to be issued, if the input reference (4-20mA or 0-10vdc) is lost.

2. PID set-point controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.

3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference, or for reference and actual (feedback) signal for PID controller. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20mA and 0-10vdc. The reference must be able to be scaled so that maximum reference can represent a frequency less than 60 HZ, without lowering the drive maximum frequency below 60 Hz.

4. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (enable). Upon remote, customer reset (re-closure of interlocks), drive is to resume normal operation.

5. Two (2) programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power, Kilowatts, DC Bus Voltage, or Active Reference.

6. Three (3) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 amps at 250 VAC, with continuous current rating 2 amps RMS. Outputs must be true form C type contacts. Open collector outputs are not acceptable.

F. Information Display

1. Output frequency
2. Motor speed (RPM, %, or engineering units)
3. Motor current
4. Calculated motor torque
5. Calculated motor power
6. DC buss voltage
7. Output voltage
8. Heat sink VFD temperature
9. Analog input values
10. Keypad reference values
11. Elapsed time motor
12. Kilowatt-hour meter
13. Internal self-diagnostics
14. Fault conditions:
    a. External fault
    b. Processor line fault

c. Low AC line voltage
d. High AC line voltage
e. Current overload
f. High DC buss voltage
g. VFD output fault

## 2.04 ENCLOSURE

A. All VFD components shall be enclosed in a NEMA-1 enclosure for indoor applications, unless the installed location dictates the need for additional protection from physical or water damage in which case a NEMA-12 enclosure shall be used. For outdoor locations, provide NEMA 3R steel (metal) enclosure.

B. For VFDs with internal bypass, provide side-by-side configuration, with bypass compartment to the side of the drive compartment, rather than below the drive compartment, to allow a more convenient service access.

## 2.05 CONTROL

A. All control adjustments shall be made without the necessity of an extender board of specialized meters, but rather from front access adjustable potentiometers or keypad.

B. Low voltage logic and 115 V control circuits shall be electrically isolated from the power circuits. Signal circuit common shall be grounded.

C. The VFD shall include a power ride-through feature to allow continuous operation through up to a three to five cycle line loss.

D. Electronic output overload protection shall be provided to eliminate the use of bimetallic overloads. The drive shall not be phase sequence sensitive.

E. The VFD shall have independently adjustable acceleration and deceleration circuits of 5 to 120 seconds. Extended time periods are also acceptable.

F. The VFD shall have full function output current limit adjustable from 10 to 100 percent.

## 2.06 SYSTEM OPERATION

A. Selector switch in the "off" position - the controller run circuit shall be open and the system shall not operate.

B. Selector switch in the "hand" position - the speeds of the motors shall be

controlled by the manual speed potentiometer or keypad.

C. Selector switch in the "auto" position - operation shall be via the input 0 to 10 VDC signal with the output speed proportional to the input signal. If required for incorporation into the controls scenario, the VFD manufacturer shall furnish a pressure transducer mounted in the drive enclosure to convert a 3 to 15 psi pressure signal to a 0 to 10 VDC signal.

D. The bypass switch shall provide the ability to service the control in bypass operation while not de-energizing the motor. It shall also allow for start/stop functions for the motor.

E. In case of an output ground fault or similar abnormal output condition, any VFD serving multiple units shall be able to automatically alternate its output to either the duty device or the standby device. The VFD shall be fully operational after an output ground fault condition.

2.07 COMMUNICATIONS

A. The VFD shall have EIA-485 and EIA-232 ports as standard.

B. The VFD shall communicate with PLCs, DDCs, Metasys N2 bus, BACnet, Modbus and other communication protocols as required by the project. Provide components required for interface with the selected Building Automation System. Coordinate with BAS contractor.

C. Communication capabilities shall include, but not be limited to, run-stop control, speed set adjustment, current limit, and proportional/integral/derivative (PID) controller adjustments, accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as output speed/frequency, current, % torque, % power, kilowatt-hours, relay outputs, and diagnostic fault information.

D. The VFD shall have a serial port to download drive parameters and fault logs.

E. The VFD shall have programmable input and outputs.

## PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate the following VFD options with the Owner and the Design Engineer.

1. Requirements for external bypass switch to operate equipment while VFD is inoperative or being repaired

2. Requirements for external 3-contactor Drive/Off/Bypass/Test switch that allows operation of the motor via line power in the event of VFD failure

3. Communications interface with building and temperature controls

4. Requirements for input line reactors for harmonic suppression

5. Requirements for output line reactors for motor protection

6. Requirements for 6, 12, or 18 pulse shifting transformer or Active Harmonic Filtering (AHF) to minimize total harmonic distortion

7. Maintenance department desire for removable VFD keypad with LCD and memory storage

3.02 INSTALLATION

A. Install VFDs in accordance with manufacturer's instructions.

B. Install floor mounted units on concrete house-keeping pads.

C. For wall hung units, Contractor shall provide unistrut mounting bracket for drives. Contractor shall reinforce the wall studs with bracing as required to adequately support the drive.

D. Installation of the VFD shall allow for clearance in front of the drive as required by the latest revision of the National Electrical Code for an electrical panel.

E. Drive shall be mounted so that keypad and display height are located between 3' to 5'-6" AFF, or top of drive no higher than 6' AFF when display cannot be mounted per these dimensions. Drive and option cabinet configuration shall be provided which conforms to this requirement.

F. VFD Protection and Cleaning

1. The VFD shall be protected from all construction dust, debris, physical damage, and electrical damage during construction. The VFD shall not be operated until ventilation inlets and outlets are protected with filter medial to prevent dust and debris from entering and damaging electronic components. Filtration shall remain in place throughout construction.

2. The VFD shall be cleaned by a qualified drive technician, both internally and externally, including the heat sinks. All cooling fans shall be replaced with factory replacements. Cleaning and fan replacement shall occur at project substantial completion.

1.09 TRAINING

A. The manufacturer shall provide and present to the Owner, at no additional cost to the Owner, a training and trouble-shooting course at the Owner's location. The trainer shall be certified and factory trained by the equipment manufacturer. The course shall be made available to the Owner's maintenance personnel within 30 days of start-up.

B. The instruction shall be comprised of two, 4-hour classes, with each class covering the same material. At the Owner's option, the class shall be given on separate days. One hour of each class shall be a classroom review of project specific equipment and operational needs, one hour shall be a classroom review of troubleshooting techniques and two hours shall be hands-on, in the building, reviewing actual equipment operation and system troubleshooting techniques. Each class shall be for approximately four people.

C. The trainer shall provide visual aids, documentation, and circuit diagrams for each attendee. Operation and maintenance manuals shall be in the Owner's possession two days prior to start of the class.

D. This training is not to be construed as a sales pitch, but rather to familiarize the maintenance technicians with the care, troubleshooting, servicing, and operation of the equipment and systems installed.

1.10 TESTING

A. To ensure quality and minimize infantile failures at the job site, the VFD shall be burned in by the manufacturer. The VFD shall operate a dynamometer at full load and the load and speed shall be cycled during the test.

B. All optional and special features shall be functionally tested at the factory for proper operation.

C. Records of this factory testing shall be provided with VFD shipment and included in the Operation and Maintenance manuals.

D. VFD's shall be shipped to the air handling unit, pump, or fan manufacturer for testing. The units shall be operated over the full speed range to certify vibration limits are met.

## 1.11 START-UP

A. Start-up shall be provided within two weeks of notification by the Contractor or the Owner.

B. The VFD manufacturer shall provide a factory trained and certified technician to check the installation, start the VFDs and place them into operation.

C. Provide a certified start-up report, listing the following:

1. Drive and motor nameplate data
2. Physically installed location of the drive, including building, room number, and room name
3. Date of start-up
4. Start-up data pertinent to specific drive operation
5. Signature and printed name of the certified technician performing the start-up

D. A copy of the start-up report shall be included in the Operation and Maintenance manual.

E. Include instructions for contacting the service organization with each set of start-up documents. Instructions shall include name of service organization, address and phone number, and instructions for how to contact the service provider.

F. Any remedial action required for harmonic distortion and line notching shall be at the manufacturer's expense. Manufacturer shall assist Owner in determining the optimum capacitance for power factor correction and avoidance of potential resonance problems. If the harmonic study indicates that harmonic levels of the facility are within IEEE 519 limitations, then line reactors are not required.

END OF SECTION

# SECTION 26 32 13 – PACKAGE ENGINE GENERATOR SYSTEMS

## PART 1 – GENERAL

### 1.1. SCOPE

A. Provide complete factory assembled generator set equipment with digital electronic controls.

B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

### 1.2. CODES AND STANDARDS

A. The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
2. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
3. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
4. FCC Part 15, Subpart B.
5. IEC8528 part 4. Control Systems for Generator Sets.
6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
7. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
8. IEEE587 for voltage surge resistance.
9. NEMA ICS10-1993 – AC Generator sets.
10. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
11. NFPA99 – Essential Electrical Systems for Health Care Facilities.
12. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
13. UL508. The entire control system of the generator set shall be UL508 listed and labeled.

B. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3. ACCEPTABLE MANUFACTURERS

A. Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based generator sets manufactured by Cummins Onan. Equipment by other suppliers that meets the requirements of this specification is acceptable, if approved not less than 2 weeks before scheduled bid date. Proposals must include a line by line compliance statement based on this specification.

PART 2 – PRODUCTS

2.1. GENERATOR SET:

A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage as specified on drawing.
2. The generator set shall be rated as specified on drawing at 0.8 PF, based on site conditions of Altitude 2.024 ft., ambient temperatures up to 105$^{o}$ F.
3. The generator set rating shall be based on emergency/standby service.

B. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
3. The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.

6. The generator set shall share real and reactive load proportionally within plus or minus 5% with all other generator sets in the system.
7. The time required to automatically start, accelerate to rated speed and voltage, synchronize and parallel all generator sets to the system bus on a normal power failure shall not exceed 15 seconds, assuming that the generator set is in an ambient temperature of 40F or greater, and water jacket heaters are operating properly.

C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails
2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
3. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.2. Engine and Engine Equipment

A. The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

B. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.

C. Skid-mounted radiator and cooling system rated for full load operation in 122° F (50° C) ambient as measured at the generator air inlet, based on 0.5 in $H_2O$ external static head. Radiator shall be sized based on a core temperature which is 20° F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.

D. Electric starter(s) capable of three complete cranking cycles without overheating.

E. Positive displacement, mechanical, full pressure, lubrication oil pump.

F. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

G. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.

H. Replaceable dry element air cleaner with restriction indicator.

I. Flexible supply and return fuel lines.

J. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

K. Coolant heater

1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
3. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

4. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100º F (40C) in a 40º F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

L. Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

M. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

N. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

O. A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger may be located in an automatic transfer switch, or may be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:

1. Loss of AC power - red light
2. Low battery voltage - red light
3. High battery voltage - red light
4. Power ON - green light (no relay contact)
5. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses

## 2.3. AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105º C (Centigrade).

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The sub-transient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

2.4. GENERATOR SET CONTROL.

A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

B. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. The generator set mounted control shall include the following features and functions:

D. Control Switches

1. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
3. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
4. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

E. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

1. Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
2. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
3. Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.

F. Generator Set Alarm and Status Display.

1. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
   a). low oil pressure (alarm)
   b). low oil pressure (shutdown)
   c). oil pressure sender failure (alarm)
   d). low coolant temperature (alarm)
   e). high coolant temperature (alarm)
   f). high coolant temperature (shutdown)
   g). engine temperature sender failure (alarm)
   h). low coolant level (alarm or shutdown--selectable)
   i). fail to crank (shutdown)
   j). fail to start/overcrank (shutdown)
   k). overspeed (shutdown)
   l). low DC voltage (alarm)
   m). high DC voltage (alarm)
   n). weak battery (alarm)
   o). low fuel-daytank (alarm)
   p). high AC voltage (shutdown)
   q). low AC voltage (shutdown)
   r). under frequency (shutdown)
   s). over current (warning)
   t). over current (shutdown)

u). short circuit (shutdown)
v). ground fault (alarm) (optional--when required by code or specified)
w). over load (alarm)
x). emergency stop (shutdown)

2. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

G. Engine Status Monitoring.

1. The following information shall be available from a digital status panel on the generator set control:
   a). engine oil pressure (psi or kPA)
   b). engine coolant temperature (degrees F or C)
   c). engine oil temperature (degrees F or C)
   d). engine speed (rpm)
   e). number of hours of operation (hours)
   f). number of start attempts
   g). battery voltage (DC volts)
2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

H. Engine Control Functions.

1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
2. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
3. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
4. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
5. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of

discriminating between failed sender or wiring components, and an actual failure conditions.

6. The control system shall include all interfaces necessary for proper operation with the paralleling equipment provided under this contract. The generator set supplier shall be responsible for complete compliance to all specification requirements for both the generator set and the paralleling equipment.

I. Alternator Control Functions:

1. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
2. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
3. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
4. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
5. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no

intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

6. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.
7. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

J. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(s) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

K. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set on a continuous basis. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

L. Control Interfaces for Remote Monitoring:

1. All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

2. Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
3. One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
4. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
5. A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
6. The control shall be provided with a direct serial communication link for the LonWorks communication network interface as described elsewhere in this specification and shown on the drawings.

## 2.5. OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATING HOUSING

A. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 95 dBA at any location 7 meters from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass.

B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

C. The enclosure shall be provided with an exhaust silencer which is mounted outside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a raincap and rainshield.

D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer’s standard color. All surfaces of all metal parts shall be primed and painted.

E. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

F. A sub-base fuel tank shall be included to supply a minimum of 24 hrs. Run time at full load. Tank shall be dual wall and UL listed.

## 2.6. OPERATION

A. Sequence of Operation

1. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.
2. The generator set shall complete a time delay start period as programmed into the control. The contractor shall coordinate this time delay with the power company's primary transfer switch.
3. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
   a). The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
   b). The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".
   c). The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
4. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.
5. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.
6. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.
   a). Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

## 2.7. ENGINE EXHAUST SYSTEM

A. The engine exhaust system shall be of the double-wall, factory-built type for use with diesel engines or turbines as described in NFPA 37 which produce exhaust

at temperatures not exceeding 1400ºF continuously or 1800ºF intermittently.

B. Engine exhaust system shall be listed for an internal static pressure of 60 inches w.g.

C. The exhaust pipe sections shall be constructed of an inner wall and an outer wall with a 1” insulating air space.

1. The inner wall shall be constructed of .035” thick type 304 stainless steel for diameters 6” through 36” and .048” thick for diameters 38” through 48”.
2. The outer wall shall be constructed of .024” thick aluminized steel for sizes 6” through 24” and .034” thick for sizes 26” through 48”.
3. Inner and outer walls shall be connected by means of spacer clips which maintain the concentricity of the annular space and allow unobstructed, differential thermal expansion of inner and outer walls.

D. All exhaust pipe parts exposed to the atmosphere shall be protected by one (1) coat of corrosion and heat resistant primer and one (1) coat heat resistant paint.

E. All supports, drains, roof penetrations, terminations, flange adapters, and fittings required to install the exhaust pipe shall be included. Lined bellows joints shall be used to compensate for expansion. Provide relief valve where indicated on plans.

F. All inner pipe joints shall be held together by means of formed vee bands and sealed with PO71, High Temperature Sealant.

1. Where exposed to weather, the outer bands shall be sealed with P077 Silicone Sealant to prevent rain water from entering the space between the inner and outer walls. Paint shall be furnished and applied by installer.
2. Screws shall be of the hex head type with shoulder stops and tapered 'lead-in' threads for easy starting.
3. Nuts for the inner and outer bands shall be retained by means of a free-floating cage to allow easy alignment.
4. Seal clips should be used in conjunction with vee bands on diameters 6 thru 10 inch.

G. Exhaust system shall terminate three feet above roof or as required by local codes.

H. AVAILABLE MANUFACTURERS The exhaust system shall be Model PIC Pressure Industrial Chimney as manufactured by Metal Fab,

2.8. OTHER REQUIREMENTS

A. Submittals: Within 10 days after award of contract, provide six sets of the following information for review:

1. Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
2. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
3. Manufacturer's certification of prototype testing.
4. Manufacturer's published warranty documents.
5. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
6. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
7. Manufacturer's installation instructions.

PART 3 – EXECUTION

3.1. FACTORY TESTING:

A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

3.2. INSTALLATION:

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on six (6) inch concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.3. ON-SITE ACCEPTANCE TEST:

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.4. TRAINING:

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.5. SERVICE AND SUPPORT:

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.6. WARRANTY:

A. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. `The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts costs or other charges.

END OF SECTION 26 32 13

# SECTION 26 56 00 – EXTERIOR LED LUMINAIRES

## PART 1 – GENERAL

### 1.1. SUMMARY

A. Section includes exterior luminaries, poles, and accessories.

### 1.2. REFERENCES

A. ANSI C78.377-2011 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products

B. ANSI C82.77-2002 (or latest), American National Standard for Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment

C. ANSI C136.2-2014 (or latest), American National Standard for Roadway and Area Lighting Equipment – Dialectric Withstand and Electrical Immunity Requirements

D. ANSI C136.10-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacles— Physical and Electrical Interchangeability and Testing

E. ANSI C136.15-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification

F. ANSI C136.22-2004 R2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

G. ANSI C136.31-2010 (or latest), American National Standard for Roadway Lighting Equipment – Luminaire Vibration

H. ANSI C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment - Solid State Light Sources Used in Roadway and Area Lighting

I. ANSI C136.41-2013 (or latest), American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

J. IESNA LM-50-13 (or latest), IES Approved Method for Photometric Measurement of Roadway and Street Lighting Installations

K. IESNA LM-63-02 (R2008 or latest), ANSI/IESNA Standard File Format for the Electronic Transfer of Photometric Data and Related Information

L. IESNA LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

M. IESNA LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources

N. IESNA RP-8-00 (or latest), ANSI / IESNA American National Standard Practice for Roadway Lighting

O. IESNA RP-16-10 (or latest), ANSI/IES Nomenclature and Definitions for Illuminating Engineering

1.3. SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Luminaire cutsheets

C. Cutsheets for LED light source(s)

D. Cutsheets for LED driver(s)

E. If dimmable LED driver is specified, provide diagrams illustrating light output and input power as a function of control signal.

F. Cutsheets for surge protection device, if applicable

1.4. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

1.6. COORDINATION

A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.

PART 2 – PRODUCTS

2.1. WARRANTY

A. Luminaires and drivers shall be warranted for a period of 10 years.

## 2.2. LUMINAIRES

A. Product Description: Complete exterior luminaries assemblies, with features, options, and accessories as scheduled.

B. Luminaire shall be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Testing Laboratory (NRTL).

C. Luminaire shall have locality-appropriate governing mark and certification.

D. Luminaire shall meet the performance requirements specified in ANSI C136.2 for dielectric withstand, using the DC test level and configuration.

E. Luminaire shall start and operate in ambient temperature range specified.

F. Maximum rated case temperature of driver and other internal components shall not be exceeded when luminaire is operated in ambient temperature range specified.

G. Mechanical design of protruding external surfaces (heat sink fins) shall facilitate hose-down cleaning and discourage debris accumulation.

H. Liquids or other moving parts shall be clearly indicated in submittals, shall be consistent with product testing, and shall be subject to review by Owner.

I. Color Rendering Index (CRI) shall be no less than 60.

# PART 3 - EXECUTION

## 3.1. CLEANING

A. Section 01 70 00 – Execution Requirements and 26 05 00 – General Electrical Requirements: Final cleaning.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

## 3.2. PROTECTION OF FINISHED WORK

A. Section 01 70 00 – Execution Requirements: Protecting finished work.

B. Relamp luminaries having failed lamps at Substantial Completion.

END OF SECTION 26 56 00

# SECTION 32 31 13 - CHAIN-LINK FENCES AND GATES

## PART 1 - GENERAL

### 1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2. SUMMARY

A. This Section includes the following:

1. Chain-Link Generator Fence:
2. Chain-Link gates: Swing.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete post concrete fill.

### 1.3. SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.
4. Accessories: Privacy slats including color chart.

### 1.4. QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

### 1.5. PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1. CHAIN-LINK FENCE FABRIC

A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: Metallic-coated wire with a diameter of 0.120 inches.
   a). Mesh Size: 2 inches.
   b). Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before or after weaving.

2.2. GENERATOR FENCE AND GATE FRAMING

A. Posts and Rails: Round cold-formed, electric-resistance-welded, steel pipe or tubing, with minimum yield strength of 45,000 psi and with outside dimension, minimum wall thickness, and weight complying with ASTM F 761 or ASTM F 654 for the following fence height and strength and stiffness requirements:

1. Fence Height: 6 ’-0” min. above adjacent grade.
2. Duty Rating: Medium.
3. Tube Size and Thickness:
   a). Top Rail: 1.66 inches .
   b). Line Post: 1.66 inches
   c). Terminal Post: 1.90 inches .
   d). Tube or Pipe Thickness: 0.065 inch .
4. Gates: Comply with ASTM F 654 and the following:
   a). Type: II, single swing at playground double swing at trash enclosure frame tubing.
   b). Fabric Height: 6 ’-0” for generator enclosures.
   c). Leaf Width: (2) 5’-0” at generator enclosures.
5. Hardware: Latches permitting operation from both sides of gate, hinges, center stops, cane bolt and keeper.
6. Metallic-Coated Steel: Posts, rails, and frames protected with an external coating of not less than 0.6 oz. of zinc/sq. ft., a chromate conversion coating, and a clear, verifiable polymer film; with an internal protective coating of not less than 0.6 oz. of zinc/sq. ft. or 81 percent, not less than 0.3-mil-thick, zinc pigmented coating.

2.3. TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:

1. Location: Extended along bottom of fence fabric.

B. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 817, ASTM A 824, and the following:

1. Metallic Coating: Type II, zinc coated (galvanized) by hot-dip process, with the following minimum coating weight:
   a). Matching chain-link fabric coating weight.

2.4. FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive top rail.

C. Rail and Brace Ends: Attach rails securely to each corner, pull, and end post.

D. Tension and Brace Bands: Pressed steel.

E. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post.

F. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
   a). Hot-Dip Galvanized Steel: 0.106-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
   b). Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; 0.148-inch- diameter, mill-finished wire.

2.5. PRIVACY SLATS

A. Material: PVC, UV-light stabilized, not less than 0.023 inch thick; sized to fit mesh specified for vertical installation.

B. Color: As selected by owner from manufacturer's full range.

C. Location: Privacy slats at trash enclosures and trash enclosure gates only.

## PART 3 - EXECUTION

### 3.1. EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2. PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 50 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3. INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

### 3.4. CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing's indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at spacing not to exceed 10 feet into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect above ground portion of posts from concrete splatter.
   a). Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.

C. Terminal Posts: Locate terminal end and corner per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

D. Line Posts: Space line posts uniformly at 10 feet o.c.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end posts and at both sides of corner and pull posts.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric.

1. Bottom Tension Wire: Install tension wire within 4 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Chain-Link Fabric: Apply fabric to inside of enclosing framework. Leave 1 inch between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

L. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Vertically.

3.5. GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper- resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6. ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 31 13

# TECHNICAL SPECIFICATIONS

FOR

## ASBESTOS ABATEMENT PROJECT

OF

***ASBESTOS CONTAINING BUILDING MATERIALS:***

**Blanket Boiler Insulation**

**Subject Property:**

**Building 550 – Boiler Room**
**San Angelo State Living Center**
11640 N HIGHWAY 87
**Carlsbad, TX 76934**

**NAAL Project Number:** 2018046015

**Signature:** _____ **Date:** 10-12-18

*Prepared By:*
Denny E. Walker, IAC License #10-5023 - Expiration date: 12/20/2019
North American Analytical Labs Inc. – 1217 E.S. 11th Suite B
Abilene, TX 79602 (325) 672-4777 – Fax (325) 672-4727

**San Angelo SSLC Emergency Generators and Mechanical System Upgrade**
**Project Number: 18-131-SGL**
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# Project Organizational Breakdown

PROJECT NAME: SASSLC Boiler Room - NAAL PN. 2018046015

OWNER: San Angelo State Supported Living Center

OWNER'S REPRESENTATIVE: Refer to Division 0 Procurement & Contracting Requirements

AIR MONITORING TECHNICIAN (AMT):

Denny Walker, John Schlittler, or Jim Convertine
North American Analytical Labs, Inc. (NAAL)
1217 E.S. 11th, Suite B
Abilene, TX 79602

PROJECT MANAGER:

Denny Walker, John Schlittler, or Jim Convertine
North American Analytical Labs, Inc. (NAAL)
1217 E.S. 11th, Suite B
Abilene, TX 79602

TEXAS CONSULTANT/
PROJECT ADMINISTRATOR:

Denny E. Walker, IAC
North American Analytical Labs, Inc. (NAAL)
1217 E.S. 11th, Suite B
Abilene, TX 79602

NOTE: In the specifications, the Owner's Representative, Project Manager and Project Administrator are listed for many various responsibilities. To reduce the workload of the Owner's Representative as it pertains to Work under this project, all Contractor submissions to and contact with the Owner's Representative will be through the Project Manager who will coordinate with the Project Administrator and Owner's Representative.

The people listed above are authorized by Denny E. Walker to act on behalf of NAAL Inc. as both Project Managers and Air Monitoring Technicians on this project. This statement is meant to comply with the TDSHS regulations for the written notification of responsibilities for this project, please see consultant signature below.

Project Schedule Overview:
Refer to Division 0 Procurement & Contracting Requirements for the following:

PRE-BID MEETING, BID DUE DATE, CONTRACT AWARD DATE, and START DATE

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PROJECT END DATE: Within fifty (50) days of abatement start date, coordinate with Division 0 Procurement & Contracting Requirements

TDSHS NOTIFICATION: NAAL, Inc. will submit the "Texas Department of State Health Services Demolition/Renovation Notification Form" to the State.

PART 1 - GENERAL

1.1. SUMMARY OF WORK - ASBESTOS ABATEMENT

II. A. 1. - SUMMARY OF WORK - ASBESTOS ABATEMENT
Abbreviated Written Summary: Briefly and without force and effect upon the contract documents, the work of the Contract can be summarized as follows:

General:
The objective of this project is the safe and complete removal of the following ACBM boiler insulation and associated pipe insulation. The Contractor will have the responsibility of properly carrying out all tasks required in these specifications. Additional tasks per this specification shall include (but is not limited to) proper cleaning of all work areas; properly disposing of all wastes and completely documenting the entire project. All areas to be abated and materials used must be properly decontaminated. Encapsulate must be applied if applicable or as directed by the Project Manager.

Specific:
All materials to be removed and containment areas are listed in, Section C "SCOPE OF WORK/PROJECT DRAWINGS", of this specification; only those materials are to be abated. The following is a list of Containment Configurations and Removal Techniques that the Contractor must use to remove the materials that fall into those particular categories. The Contractor is responsible for conforming to all federal, state, and local regulations regarding the removal of asbestos containing materials. All unattached movable objects will be removed from the area prior to commencement of removal in containment.

Containment Configurations:

Boiler & Pipe Insulation (full prep);
*This is an OSHA Class I removal activity of Regulated Asbestos Containing Material (RACM).*
The project requires a complete isolation of the boiler to be accomplished by the construction of framing to be used to attach 2 layers of 6 millimeter (mil) polyethylene (poly). The containment will extend from floor to the roof deck to include fire retardant polyethylene walls, ceiling, and floor. All area's to be abated will be sealed from non-abatement areas by critical barriers and a fully functional decontamination unit will be erected and utilized for decontamination of personnel, and equipment, A separate waste decontamination unit will be installed on the north end of the containment and used only

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for asbestos waste load out. Negative pressure will be established and all units will be exhausted outside of the building using windows or secured door opening with 1/2" plywood & 2"x4" frame. The containment poly will consist of 6mil fire retardant for both the floor and the walls. The decontamination unit and all critical barriers will also be constructed of 6mil poly and establish negative pressure. All personnel will wear full Personal Protective Equipment (PPE).

The boiler metal exterior will be removed in containment under full negative pressure.

Pipe Fitting Insulation (Various sizes), - Glovebag - if used;
*This is an OSHA Class I removal activity of Regulated Asbestos Containing Material (RACM).*
The goal of this containment is to isolate the pipe runs/fittings/tee's/elbows/valves found at each removal location by creating a regulated area, placing 6mil poly drop cloth under each removal area. Once the glove bags are hung the Contractors Supervisor and the Project Manager will perform a visual inspection of the prep. Removal will commence once the Supervisor and Project Manager approve the glove bag installation. The Contractor will have a remote decontamination unit set up within each of the buildings where the glove bag procedure is being performed. Personnel will double suit and wear full Personal Protective Equipment (PPE). Worker decontamination will be accomplished using the decontamination unit installed in the boiler containment.
Removal Techniques:
The Contractor will utilize wet removal techniques for all of the abatement performed under the scope of this contract.

All work will be accomplished with certified and licensed personnel. The contain construction and integrity will be inspected prior to commencement of the work by the Contractor Supervisor (CS) and the Project Manger (PM) Air Monitoring Technician (AMT). Both the CS and PM/AMT will be onsite during all phases of construction and abatement.

The Contractor will utilize wet removal techniques during the removal of all ACM in this removal project. The Contractor will dispose of the all asbestos containing materials abated in this project as asbestos containing waste in accordance with the DOT regulations, TECQ regulation, and the Texas Asbestos Health Protection Rules. The containment will be cleaned. A visual inspection will be performed by the Project Manager and Project Supervisor. An encapsulant will be applied, verified and allowed to dry a minimum of four hours under the direction of the Project Manager.

The Contactor will place all regulated waste generated from this removal in 6 mil poly bags, place bags in a fully poly lined enclosed trailer, complete a TNRCC/TECQ "Uniform Hazardous Waste Manifest" and dispose of at a landfill approved by NAAL Inc. for this type of waste.

All Abatement personnel will wear full Personal Protective Equipment (PPE) with a

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minimum of a half mask respirator during all removal activities for the work outlined in this specification.

Disposal:
*Asbestos Containing Waste:*
The Contractor will have a fully enclosed dumpster or trailer placed at a location designated by the Consultant. All asbestos containing waste generated from this removal in 6-mil poly bags, will place bags in a fully poly lined dumpster or trailer. All waste generated from any given containment will be taken out of that containment on a daily basis and placed in this dumpster or trailer. The dumpster will be fully plasticized prior to any asbestos waste being placed in the dumpster. The asbestos containing waste will be TNRCC/TECQ "Uniform Hazardous Waste Manifest" manifested and buried in a landfill approved to accept asbestos containing waste. Follow all procedures outlined in Section B. 02 "Disposal of Asbestos" by NAAL, Inc.

Clearance: This containment will *require PCM clearances* as outlined in section II. A. 17. Pages 1-3

Special Considerations:
1) The Contractor will maintain a manometer to measure the air pressure in the containment. The manometer will be equipped with a functional strip recorder and all recordings will be copied and the copy supplied to the Project Manager or Project Consultant in the Contractors final report. The containment will be maintained at or above -.02 inches of water column.
2) The Consultants personnel will conduct OSHA air monitoring for the Contractor if hired to do so. The Contractor is not required to utilize the services of NAAL. But must have personnel samples collected and analyzed by appropriately licensed personnel. The fee to the Contractor from NAAL, Inc. will be $150.00 per day for the project. This will be for a work force up to ten (10) personnel. Fee for additional personnel will $25.00 per individual in excess of ten. This fee is payable to Consultant at completion of the project. If the Contractor does not submit any other company documentation i.e. licenses, certs or have any other company on site at the time that personnel samples are required, then NAAL Inc. is hired by the abatement contractor by default.
3) A licensed Electrician must install the GFCI board hook ups into the electrical panels as needed. All cords running to the GFCI board(s) from the electrical panels MUST be securely taped to the floor and keep away from the reach of the general public, and the owner's employee's. All electrical cords used on this project must be equipped with GFCI plugs built in to the cord or at a minimum each cord must be plugged into a GFCI adapter plug. All cords running to the work area must be securely taped to the floor.
4) The Contractor will be responsible for site security at all times, 24 hours a day. The Contractor must have a individual on site at any time that a regulated area has been establish.
5) Spray glue must not be sprayed on any surfaces other than poly or the construction critical barriers
6) All negative air machines will be rated at 60% of the manufacturer specified capacity. ie: a machine with a manufacturer rating to pull 2500cfm will be considered to be pulling

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1500cfm. A backup negative air machine will be required to be installed to each containment and ready to turn on at all times.
7) All containments will require lockdown after completion of abatement and achievement of a visual clearance and PCM clearances by the asbestos project managing air monitoring technician. Lockdown will be allowed at least 4 hours of drying time prior to collecting the PCM clearances.
General and Administrative Requirements: Are set forth in the following specification sections:

II.A.01. *Summary of the Work* - Asbestos Abatement
II.A.02. *Project Coordination* - Asbestos Abatement
II.A.03. *Definition and Standards* - Asbestos Abatement
II.A.05. *Schedules, Reports, Payments* - Asbestos Abatement
II.A.06. *Shop Drawings, Product Data and Samples*
II.A.14. *Products and Substitutions*

Abatement Work: Requirements are set forth in the following specification sections, listed here according to the sequence of the work:

II.A.04. *Applicable Codes* - Asbestos Abatement - Sets forth governmental regulations and industry standards which are included and incorporated herein by reference and made a part of the specifications. This section also sets forth those notices and permits which are known to the Owner and which either must be applied for and received, or which must be given a governmental agencies before start of work.
II.A.07. *Test Laboratory Services* - Describes air monitoring by owner so that the building beyond the work area will remain uncontaminated. Air monitoring to determine required respiratory protection is the responsibility of the contractor.

II.A.08. *Temporary Facilities* - Asbestos Abatement - Sets forth the support facilities needed, such as electrical and plumbing connections for the decontamination unit and office space for the Project Administrator.

II.A.09. *Negative Pressure System* - sets forth the procedures to set up the negative air machines and ventilation of the work area

II.A.10. *Temporary Enclosures* - Details the requirements for the sheet plastic barriers isolating the work area from the balance of the building or the outside environment.

II.A.11. *Worker Protection* - Asbestos Abatement - Describes the equipment and procedures for protecting workers against asbestos contamination and other work place hazards except respiratory protection.

II.A.12. *Respiratory Protection* - Sets forth the procedures and equipment required for adequate protection against inhalation of airborne asbestos fibers.

II.A.13. *Decontamination Units* - Explains the setup and operation of the personnel

and material decontamination units.

Asbestos Removal Work Procedures: Are described in the following specification sections:

II.B.1. *Removal of Asbestos* Containing Materials
II.B.2. *Disposal of Asbestos* Containing Waste Material

Decontamination of the Work Area - After completion of abatement work is described in the following sections:

II.A.15. *Project Closeout* - Details the closeout procedures to end the project once abatement work is complete including final paperwork requirements.

II.A.16. *Project Decontamination* - Describes the sequence of cleaning and decontamination procedures to be followed during removal of the sheet plastic barriers isolating a work area.

II.A.17. *Work Area Clearance* - Describes the analytical methods used to determine if the work area has been successfully cleaned of contamination.

PLAN OF ACTION (REQUIRED SUBMITTAL):

At the pre-work conference submit a detailed plan of the procedures proposed for use in complying with the requirements of this specification. Include in the plan the location and layout of decontamination areas, the sequencing of asbestos work, the interface of trades involved in the performance of work, methods to be used to assure the safety of building occupants and visitors to the site, disposal plan, including location of approved disposal site, and a detailed description of the methods to be employed to control pollution. Describe the use of portable HEPA ventilation system, closing out of the building HVAC system, method of removal to prohibit visible emissions in work area, and packaging of removed asbestos waste.

POTENTIAL ASBESTOS HAZARD:

The disturbance or dislocation of asbestos-containing materials may cause asbestos fibers to be released into the building's atmosphere, thereby creating a potential health hazard to workmen and building occupants. Apprise all workers, supervisory personnel, subcontractors and consultants who will be at the job site of the seriousness of the hazard and of proper work procedures, which must be followed.

Where in the performance of the work; workers, supervisory personnel, subcontractors, or consultants may encounter, disturb, or otherwise function in the immediate vicinity of any identified asbestos-containing materials, take appropriate continuous measures as necessary to protect all building occupants from the potential hazard of exposure to

airborne asbestos. Such measures shall include the procedures and methods described herein, and compliance with regulations of applicable federal, state and local agencies. Compliance with said procedures and methods shall be the sole responsibility of the Contractor.

STOP WORK:

If the Owner, the Owner's Representative, or the Project Administrator presents a written stop work order - immediately and automatically stop all work. Do not restart work until authorized in writing by Owner's Representative.

ASBESTOS-CONTAINING MATERIALS:

In many cases other asbestos containing materials may be present in the building. If other ACM is present in the building it will be listed here in the specific project specification developed for that project.

Other Asbestos Containing Building Materials may be present in other areas of the building and are not a part of the scope of work for this project. All of the building materials found to contain asbestos in areas of work for this project are being abated. If any other materials are found which are suspected of containing asbestos immediately notify Project Administrator or Project Manager.

CONTRACTOR USE OF PREMISES:

*General:* The Contractor shall limit his use of the premises to the work indicated, so as to allow for Owner occupancy and use by the public.

Use of the Site: Parking. All private vehicles will use the parking area as designated by the Project Manager. The Contractor shall coordinate through the Project Administrator and block off area for special vehicle parking. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project Work.

Keep existing driveways and entrances serving the premises clear and available to the Public, Owner, and his employees at all times. Do not use these areas for parking or storage of materials. Do not use these areas for unloading of equipment and supplies.

Do not unreasonably encumber the site with materials or equipment. Coordinate with the Owner's Representative for inside storage. Confine stockpiling of materials and location of storage to the areas approved by the Project Consultant. If additional storage is necessary obtain and pay for such storage off site.

Lock automotive type vehicles, such as passenger cars and trucks and other

mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place or accessible to unauthorized persons. Loss or damage to said equipment and/or vehicles shall be the sole responsibility of the Contractor.

*Contractor's Use of the Existing Building:* Maintain existing building in a safe and weather tight condition throughout the work period. Repair damage caused by work operations. Take all precautions necessary to protect the building and its occupants during the work period.

*Contractor entrance and exit:* All normal Contractor entrance and exit shall be through areas approved at the pre-work conference.

The Contractor will restrict normal access between levels of the building to the doors entering the mechanical room.

Contractor will mark off applicable work areas with barrier tape and or construction critical barriers to prevent inadvertent access by the Public, the Vendors personnel, or the Owner employees.

Keep all areas free from accumulation of waste, rubbish or project debris.

Contractor employees will have access to any Owner restroom facilities on the premises.

Open fires will not be permitted within the building enclosure or on the premises. Smoking is allowed in designated areas only.

OWNER OCCUPANCY:

*Full Owner Occupancy:* Cooperate fully with the Owner or his representative during work operation to minimize conflicts and to facilitate Owner usage. Perform the work so as not to interfere with the Owner's operation.

The owner or his personnel must not be allowed access to any regulated area for any reason at any time.

Public Access/Occupancy:
The public must not be allowed access to any regulated area for any reason at any time.

*Vendor Occupancy:*
Any vendor’s personnel must not be allowed access to any regulated area for any reason at any time.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION (Not Applicable)
END OF SECTION - II.A.1.

1.2. PROJECT COORDINATION - ASBESTOS ABATEMENT

II. A. 2. - PROJECT COORDINATION - ASBESTOS ABATEMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Minimum administrative and supervisory requirements necessary for coordination of work on the project include but are not necessarily limited to the following:

Administrative and supervisory requirements.

Special Reports.

Notifications to other entities at job site.

ADMINISTRATIVE AND SUPERVISORY:

General Superintendent: provide a full-time General Superintendent who is experienced in administration and supervision of asbestos abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. This person is the Competent Person as required by OSHA in 29 CFR 1926.1101 for the Contractor and is the Contractor's Representative responsible for compliance with all applicable federal, state and local regulations, particularly those relating to asbestos-containing materials. This person must have completed a course at an EPA Approved and/or DSHS Training Course or equivalent certificate course as an Asbestos Contractor Supervisor asbestos abatement procedures, have had a minimum of two (2) years on-the-job training, hold a valid License from the State of Texas and meet any additional requirements set forth in 29 CFR 1926 for a Competent Person. The General Superintendent shall not be changed during the course of Work without the written permission of the Project Administrator. The General Superintendent must possess a current DSHS Contractor/Supervisor License and a current asbestos physical on the current DSHS physical form.

SPECIAL REPORTS:

*General:* Except as otherwise indicated, submit special reports directly to Owner within one day of any occurrence requiring a special report, with copy to Owner's Representative and others affected by occurrence.

Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure of negative pressure system, rupture of temporary enclosures), prepare and submit a special report listing chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. When such events are known or predictable in advance, advise Owner in advance at earliest possible date.

*Reporting Accidents:* Prepare and submit reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

*24 hour notice:* A 24 hour notice shall be given to the Owner for any proposed change to on-site supervisory personnel, change of submitted work schedule, bag out of ACM from the work area and departure of ACM to the designated landfill. The Owner's Representative will provide a form for these notices upon request.

## CONTINGENCY PLAN:

*Contingency Plan:* Prepare a contingency plan for emergencies including fire, accident, power failure, negative air system failure, supplied air system failure, or any other event that may require modification or abridgment of decontamination or work area isolation procedures. Include in plan specific procedures for decontamination or work area isolation. Nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency.

*Post:* in clean room of Personnel Decontamination unit, above described contingency plan, telephone numbers and locations of emergency services including but not limited to fire, ambulance, doctor, hospital, police, power company, telephone company.

## NOTIFICATIONS

Notify other entities at the job site of the nature of the asbestos abatement activities, location of asbestos containing materials, requirements relative to asbestos set forth in these specifications and applicable regulations.

## SUBMITTALS

Before the Start of Work: Submit the following to the Owner for review. No work shall

begin until these submittals are reviewed and approved by the Project Administrator.

*Contingency Plans:* for emergency actions as outlined above.

*Telephone Numbers:* and location of emergency services.

*Notifications:* sent to other entities at the work site.

*Pre-work Submittals:* Listed in Division II A 4. of this Project Manual are the requirements for the Contractor submittals at the Pre-Work Conference. In no event will the Contractor be authorized to abate without these requirements being signed off by the Project Administrator.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION (Not Applicable)
END OF SECTION - II. A. 2.

1.3. DEFINITIONS AND STANDARDS - ASBESTOS ABATEMENT

II. A. 3. - DEFINITIONS AND STANDARDS - ASBESTOS ABATEMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DEFINITIONS:

General Explanation: A substantial amount of specification language constitutes definitions for terms found in other contract documents, including the drawings. (Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated thereon). Certain terms used in contract documents are defined in this article. Definitions and explanations of this section are not necessarily either complete nor exclusive, but are general for the work to the extent they are not stated more explicitly in another element of contract documents.

*General Requirements*: The provisions or requirements of Division-1 sections apply to entire work of Contract and, where so indicated, to other elements which are included in project.

*Indicated:* The term "Indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated" it is for

purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

*Directed, Requested, etc.:* Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," required," "accepted," and "permitted" mean "directed by Owner's Representative," "requested by Owner's Representative," and similar phrases. However, no such implied meaning will be interpreted to extend Owner's Representative's responsibility into Contractor's responsibility for construction supervision

*Approve:* Where used in conjunction with Owner's Representative's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations of Owner's Representative's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Owner's Representative be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents.

*Project Site:* The space available to contractor for performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of project site is shown on the drawings, and may or may not be identical with the description of land upon which the project is located.

*Furnish:* Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

*Install:* Except as otherwise defined in greater detail, term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing protecting, cleaning and similar operations, as applicable in each instance.

*Provide:* Except as otherwise defined in greater detail the term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

*Installer:* The entity (person or firm) engaged by Contractor, or its subcontractor or sub-subcontractor for performance of a particular unit of work at project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

*Testing Laboratory:* A independent entity engaged to perform specific inspections or tests of the work, either at project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

*Project Administrator:* The Project Administrator is a full time representative of the Owner at the job site with authority to stop the work upon verbal order if requirements of

the contract documents are not met, or if in the sole judgment of the Project Administrator, Owners' Representative, or Owner, the interest of the Owner, safety of any person or the Owner's property are jeopardized by the work.

*General Superintendent*: The Contractor's representative at the work site. This person will generally be the Competent person required by OSHA in 29 CFR 1926 1101.

DEFINITIONS RELATIVE TO ASBESTOS ABATEMENT:

*Aerosol:* A system consisting of particles, solid or liquid, suspended in air.
*Air Cell:* Insulation normally used on pipes and duct work that is comprised of corrugated cardboard which is frequently comprised of asbestos combined with cellulose or refractory binders.
*Air Monitoring:* The process of measuring the fiber content of a specific volume of air.
*Amended Water:* Water to which a surfactant has been added.
*Asbestos:* The asbestiform varieties of serpentine (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite-tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.
*Asbestos-Containing Material (ACM):* Any material containing more than 1% by weight or visual estimate of asbestos of any type or mixture of types.
*Asbestos-Containing Waste Material:* Any material which is or is suspected of being or any material contaminated with an asbestos-containing material which is to be removed from a work area for disposal.
*Authorized Visitor:* The Owner, the Owner's Representative, the Project Administrator, testing lab personnel, or a representative of any federal, state and local regulatory or other agency having authority over the project.

*Barrier:* Any surface that seals off the work area to inhibit the movement of fibers.
*Breathing Zone:* A hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches.

*Ceiling Concentration:* The concentration of an airborne substance that shall not be exceeded.
*Certified Industrial Hygienist (C.I.H.):* An industrial hygienist certified in Comprehensive Practice by the American Board of Industrial Hygiene.
*Construction Critical Barrier (CCB):* A critical barrier that is built with 2” x 4” wood stud frame around the opening with the ¼” to ½” plywood or sheetrock affixed to the framing with duct tape and adhesive glue to create a temporary wall. This barrier will prevent the migration of fibers from the abatement area to the non-abatement area. This barrier is also intended to prevent building occupants from entering the work area.
*Critical Barrier:* This barrier is constructed to prevent fiber migration from the abatement area to the non-abatement area. A hallway “Critical Barrier” will be constructed with a 2” x 4” wood frame around the hallway opening and sealed with 6 mil. poly affixed to the frame with duct tape and adhesive glue. Window “Critical Barriers” are constructed with

6 mil. poly affixed with duct tape.

*Demolition:* The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.
*Disposal Bag:* 6 mil. thick leak-tight plastic bags used for transporting asbestos waste from work and to disposal site. A mil. is 1/1000 of an inch or .0254 millimeters. Each is labeled as follows:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

*Encapsulate:* A material that surrounds or embeds asbestos fibers in an adhesive matrix, to prevent release of fibers.

*Bridging encapsulate:* an encapsulate that forms a discrete layer on the surface of an in situ asbestos matrix.

*Penetrating encapsulate:* an encapsulate that is absorbed by the in situ asbestos matrix without leaving discrete surface layer.

*Removal encapsulate:* a penetrating encapsulate specifically designed for removal of asbestos-containing materials rather that for in situ encapsulation.

*Encapsulation:* Treatment of asbestos-containing materials, with an encapsulant and or abated sub straights with an encapsulant.
*Enclosure:* The construction of an air-tight, impermeable, permanent barrier around asbestos-containing material to control the release of asbestos fibers into the air.

*Filter:* A media component used in respirators to remove solid or liquid particles from the inspired air.
*Friable Asbestos Material:* Material that contains more than 1.0% asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

*Glovebag:* A sack (typically constructed of 6 mil. transparent polyethylene or polyvinylchloride plastic) with two inward projecting long sleeve gloves, which are designated to enclose an object from which an asbestos-containing material is to be removed.

*HEPA Filter:* A High Efficiency Particulate Absolute (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.
*HEPA Filter Vacuum Collection Equipment (or vacuum cleaner):* High efficiency particles air (absolute) filtered vacuum collection equipment with a filter system capable of collecting and retaining asbestos fibers. Filters should be of 99.97% efficiency for retaining fibers of 0.3 microns or longer.
*High-Efficiency Filter:* A filter which removes from air 99.97% or more of monodisperse dioctyl phthalate (DOP) particles having a mean particle diameter of 0.3 micrometer.

*Negative Pressure Respirator:* A respirator in which the air pressure inside the respiratory-inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.
*Negative Pressure Ventilation System:* A local exhaust system, utilizing HEPA filtration capable of maintaining a negative pressure inside the work area and a constant air flow from adjacent areas into the work area and exhausting that air outside the work area.
*Negative Pressure:* Air pressure lower than surrounding areas, generally caused by exhausting air from a sealed space (work area).

*Personal Monitoring:* Sampling of the asbestos fiber concentrations within the breathing zone of an employee.
*Protection Factor:* The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.

*Respirator:* A device designed to protect the wearer from the inhalation of harmful atmospheres.

*Surfactant:* A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

*Texas Department of Health (TDH):* The governing body for asbestos in the state of Texas.
*Texas Department of State Health Services (TDSHS):* As of September of 2004 this is the governing body for asbestos in the state of Texas. Where "Texas Department of Health or DSHS is used in this specification TDSHS is intended.
*Time Weighted Average (TWA):* The average concentration of a contaminant in air during a specific time period.

*Visible Emissions:* Any emissions containing particulate asbestos material that are visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.

*Wet Cleaning:* The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of as asbestos contaminated waste.
*Work Area:* The area where asbestos related work or removal operations are performed which is defined and/or isolated to prevent the spread of asbestos dust, fibers or debris, and entry by unauthorized personnel. Work area is a Regulated Areas as defined by 29 CFR 1926.

FORMAT AND SPECIFICATION EXPLANATIONS:

*Specification Production:* None of the following explanations shall be interpreted so as to modify the substance of the contract requirements. Portions of these specifications have been produced by Owner's Representative's standard method of editing master specifications, and may contain minor deviations from traditional writing formats. Such deviations are a natural result of this production technique, and no other meaning will be implied or permitted.

*Format Explanation:* The format of principal portions of these specifications can be described as in the following paragraphs. Although some portions of these specifications may not be in complete compliance with this format, no particular significance will be attached to such compliance or non-compliance.

*Sections and Divisions:* For convenience, basic unit of text is a "section." Each section is identified by a descriptive title (name) and number. Individual sections are grouped together with other sections of similar or related work groupings known as "divisions." Divisions are recognized as the present industry consensus on uniform specification organization and sequence. The section title is not intended to limit meaning or content of a section, nor to be fully descriptive of the requirements specified therein, nor to be an integral part of text.

Each section of specifications has been subdivided into 3 "parts" for uniformity and convenience (Part 1 - General, Part 2 - Products, and Part 3 - Execution); some sections may not require the use of all three parts. These titles do not limit the meaning of and are not an integral part of text which specifies requirements.

*Underscoring, bolding and italicizing:* are used strictly to assist the reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance of text is intended where underscoring is used.

*Imperative language:* is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by Contractor, or when so noted, by others.

*Section Numbering:* is used to facilitate cross-references in the contract documents. Sections are placed in Project Manual in alpha numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in contract documents.

*Page Numbering:* Pages are numbered independently for each section in Project Manual. The section number is shown together with the page number at the bottom of each page to facilitate the location of text in the Project Manual.

*Project Identification:* Project name/number and date of contract documents (either complete or abbreviated) are recorded at top of each page of specifications to minimize possible misuse of specifications, or confusion with other project specifications.

*Specification Content:* Because of methods of specifying to record requirements varies throughout text, and may include "prescriptive," "open generic-descriptive," "compliance" with "standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.

*Overlapping and Conflicting Requirements:* Where compliance with two or more industry standards or laws is specified, and overlapping of those different standards or laws establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into contract documents clearly indicates that a less stringent requirement is to be fulfilled. In every case the Texas Department of Health (DSHS) current law is to be strictly adhered to. All EPA, DSHS, & OSHA laws are to be strictly adhered to at all times during the course of the abatement.

*Contractor's Options:* Except for overlapping or conflicting requirements, where more than one set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether or not it is specifically indicated as such.

*Minimum Quality/Quantity:* In every instance, quality level or quantity shown or specified is intended to be the minimum for the work to be performed. Except as otherwise specifically indicated, actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of the requirements. Refer instances of uncertainty to Owner's Representative for decision before proceeding.

*Specialists, Assignments:* In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements would not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the work; they are also not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of entire set of contract requirements remains with the Contractor.

*Trades:* Except as otherwise indicated, the use of titles such as "carpentry" in specification text implies neither that the work must be performed by an accredited or

unionized tradesperson of corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradespersons of that corresponding generic name.

*Abbreviations:* The language of specifications and other contract documents is of the abbreviated type in certain instances, and implies works and meanings which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in the texts. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as singular where applicable and where full context of the contract documents so indicates.

DRAWING SYMBOLS:
*General:* Graphic symbols used on drawing are identified on the individual drawings.

INDUSTRY STANDARDS:

*General Applicability of Standards:* Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, applicable standards of the construction industry have the same force and effect (and are made a part of contract documents by reference) as if copied directly into contract documents, or as if published copies were bound herewith. Refer to the other contract documents for resolution of overlapping and conflicting requirements which result from the application of several different industry standards to the same unit of work. Refer to individual unit of work sections for indications of which specialized codes and standard the Contractor must keep at the project site, available for reference.

*Referenced Standards:* (referenced directly in contract documents or by governing regulations) have precedence over non-referenced standards which are recognized in industry for applicability to work.

*Non-referenced Standards:* are hereby defined to have no particular applicability to the work, except as general requirements of whether the work complies with standards recognized in the construction industry.

*Publication Dates:* Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date of contract documents.

*Updated Standards:* At the request of the Owner's Representative, submit a change order proposal where an applicable industry code or standard has been revised and reissued after the date of the contract documents and before the performance of the work affected. The Owner's Representative will decide whether to issue the change order to proceed with the updated standard.

*Copies of Standards:* The contract documents require that each entity performing work be experienced in that part of the work being performed. Each entity is also required to be familiar with recognized industry standards applicable to that part of the work. Copies of applicable standards are not bound with the contract documents.

Where copies of standards are needed for proper performance of the work, the Contractor is required to obtain such copies directly from the publication source.

Although certain copies of standards needed for enforcement of the requirements may be required submittals, the Owner's Representative reserves the right to require the Contractor to submit additional copies of these standards as necessary for enforcement of the requirements.

*Abbreviations and Names:* Where acronyms or abbreviations are used but not identified in specifications or other contract documents they are defined to mean the industry recognized name of trade association, standards generating organization, governing authority or other entity applicable to context of text provision. Refer to "Encyclopedia of Associations," published by Gale Research Co., available in large libraries.

*Abbreviations and Names:* The following acronyms or abbreviations as referenced in contract documents are defined to mean the associated names. Both names and addresses are subject to change, and are believed to be, but are not assured to be, accurate and up-to-date as of date of contract documents:

| | |
|---|---|
| AIA | American Institute of Architects<br>1735 New York Ave. NW;<br>Washington, DC 20006 202/626-7474 |
| ANSI | American National Standards Institute<br>1430 Broadway; New York, NY 10018<br>212/354-3300 |
| ASHRAE | American Society for Heating, Refrigerating,<br>And Air Conditioning Engineers<br>1791 Tullie Circle NE; Atlanta GA 30329<br>404/636-8400 |
| ASTM | American Society for Testing and Materials<br>1916 Race St.; Philadelphia, PA 19103<br>215/299-5400 |
| CFR | Code of Federal Regulations<br>Available from Government Printing Office;<br>Washington, DC 20402 (usually first published<br>in Federal Register) |

| | |
|---|---|
| CGA | Compressed Gas Association<br>1230 Jefferson Davis Highway;<br>Arlington, VA 22202<br>703/979-0900 |
| CS | Commercial Standard of NBS (U.S. Dept. of Commerce)<br>Government printing office; Washington, DC 20402 |
| EPA | Environmental Protection Agency<br>401 M St., SW; Washington, DC 20460<br>202/382-3949 |
| FS | Federal Specification (General Services Admin.)<br>Obtain from your Regional GSA office or purchase<br>from GSA Specifications Unit (WFSIS); 7th and D Streets;<br>SW, Washington, DC 20406<br>202/472-2205 or 2140 |
| GA | Gypsum Association<br>1603 Orrington Ave.; Evanston, IL 60201<br>312/491-1744 |
| GSA | General Services Administration<br>F St. and 18th St., NW; Washington, DC 20405<br>202/655-4000 |
| MIL | Military Standardization Documents<br>(U.S. Dept. of Defense)<br>Naval Publications and Forms Center<br>5801 Tabor Ave.; Philadelphia, PA 19120 |
| NIST | National Institute of Standards and Technology<br>(U.S. Dept. of Commerce)<br>Gaithersburg, MD 20234<br>301/921-1000 |
| NEC | National Electric Code (by NFPA) |
| NFPA | National Fire Protection Association<br>Batterymarch Park, Quincy, MA 02269<br>617/770-3000 |
| OSHA | Occupational Safety and Health Administration<br>(U.S. Dept. of Labor)<br>Government Printing Office<br>Washington, DC 20402 |

| | |
|---|---|
| PS | Product Standard of NBS<br>(U.S. Dept. of Commerce)<br>Government Printing Office<br>Washington, DC 20402 |
| DSHS | Texas Department of Health<br>Asbestos Programs Branch<br>1100 West 49th Street<br>Austin, Texas 78756<br>(800) 572-5548 |
| TDSHS | Texas Department of State Health Services<br>Asbestos Programs Branch<br>1100 West 49th Street<br>Austin, Texas 78756<br>(800) 572-5548 |
| UL | Underwriters Laboratories<br>333 Pfingsten Rd.<br>Northbrook, IL 60062<br>312/272-8800 |

*Trade Union Jurisdictions:* (NOT APPLICABLE)

SUBMITTALS:

*Permits, Licenses and Certificates:* For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

End of Section II. A. 3.

1.4. CODES & REGULATIONS - ASBESTOS ABATEMENT

II. A. 4. - CODES AND REGULATIONS - ASBESTOS ABATEMENT
PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary

Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF THE WORK

This section sets forth governmental regulations and industry standards which are included and incorporated herein by reference and made a part of the specification. This section also sets forth those notices and permits which are known to the Owner and which either must be applied for and received, or which must be given to governmental agencies before start of work.

CODES AND REGULATIONS

*General Applicability of Codes, Regulations, and Standards:* Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. During the time frame of this contract any of the existing regulations could be amended or changed if this occurs all of the amended or changed regulations are to take precedence and to be followed by the contractor. The most current regulation is to be adhered to by the contractor.

*Contractor Responsibility:* The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations. The Contractor shall hold the Owner, Owner's Representative and Project Administrator harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees, or his subcontractors.

*Federal Requirements:* which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:

Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules Title 29, Part 1910, Section 1001 and Part 1926.1101 of the Code of Federal Regulations (CFR) Respiratory Protection

Title 29, Part 1910, Section 134 of the CFR

Construction Industry

Title 29, Part 1926.1101 of the
CFR

Access to Employee Exposure and Medical Records
Title 29, Part 1910, Section 2 of the
CFR

Hazard Communication
Title 29, Part 1910, Section 1200 of the
CFR

Specifications for Accident Prevention Signs and Tags
Title 29, Part 1910, Section 145 of the
CFR

U.S. Environmental Protection Agency (EPA) including but not limited to:

Asbestos Abatement Projects Rule
40 CFR Part 762
CPTS 62044, FRL 2843-9
Federal Register, Vol 50 No 134, July 12, 1985
P28530-28540

Regulation for Asbestos
Title 40, Part 61, Sub-part A
CFR

National Emission Standard for Asbestos
Title 40, Part 61, Sub-part M (Revised Sub-part B)
of the CFR

*State Requirements:* Which govern asbestos abatement work and hauling and disposal of asbestos waste materials include but are not limited to the following:

TEXAS ASBESTOS HEALTH PROTECTION RULES, March 2006
The Texas Department of Health (DSHS)
Occupational Health Division
1100 West 49th Street
Austin, Texas 78756
(800) 572-5548

TEXAS -

Asbestos Exposure Abatement in Public Buildings
25 TAC Sections 289.141 - 289.144, 289.147 -289.151, 289.156
The Texas Department of Health
1100 West 49th Street

Austin, Texas 78756
(800) 572-5548

*Local Requirements:* Abide by all local requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials and all other legal requirements.

STANDARDS:

*Standards:* which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

American National Standards Institute (ANSI)
1430 Broadway
New York, New York 10018
(212) 354-3300

Fundamentals Governing the Design and Operation of Local Exhaust Systems
Publication Z9.2-79

Practices for Respiratory Protection Publication Z288.2-80
American Society for Testing and Materials (ASTM)
1916 Race Street
Philadelphia, PA 19103
(215) 299-5400

Specification for Encapsulants for Friable Asbestos Containing Building Materials
Proposal P-189

Safety and Health Requirements Relating to Occupational Exposure to Asbestos
E 849-82

AIA SERVICE CORPORATION

"GUIDE" SPECIFICATION - 02080 ASBESTOS REMOVAL AIA SERVICE CORPORATION
1735 NEW YORK AVENUE NW
WASHINGTON, DC

AWCI

GUIDE SPECIFICATIONS FOR THE ABATEMENT OF ASBESTOS RELEASE FROM SPRAY--OR TROWEL APPLIED MATERIALS IN

BUILDINGS AND OTHER STRUCTURAL DESIGNS.

GAO/GSA

ASBESTOS CONTROL PROGRAM
NBSIR 87-2688
GUIDELINES FOR ASSESSMENT AND ABATEMENT OF ASBESTOS-CONTAINING MATERIAL IN BUILDINGS MAY 1983

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
NATIONAL ENGINEERING LAB
CENTER FOR BUILDING TECHNOLOGY

U.S. NAVY - NAVFAC

DIVISION II.B.1
REMOVAL AND DISPOSAL OF ASBESTOS MATERIALS

VETERANS ADMINISTRATION

DIVISION II.B.1
ASBESTOS ABATEMENT SPECIFICATION

U.S. POSTAL SERVICE

TECHNICAL SPECIFICATIONS FOR TERM CONSTRUCTION CONTRACT ASBESTOS ABATEMENT

EPA GUIDANCE DOCUMENTS:

EPA Guidance Documents: which discuss asbestos abatement work or hauling and disposal of asbestos waste materials are listed below for the contractor's information only. These documents do not describe the work and are not a part of the work of this contract. EPA maintains an information number (800) 334-8571, publications can be ordered from (800) 424-9065.

Asbestos-Containing Materials in School Buildings - A Guidance Document. Part 1 & 2. (Orange Book) EPA C00090 (out of print).

Guidance for Controlling Asbestos-Containing Materials in Buildings (Purple Book) EPA 560/5-85-024

Asbestos-Containing Materials in Schools; Final Rule and Notice (40 CFR

763)

Evaluation of the EPA Asbestos-in-Schools Identification and Notification Rule. EPA 560/5-84-005

Asbestos in Buildings: National Survey of Asbestos-Containing Friable Materials. EPA 560/5-84-006.

Asbestos in Buildings: Guidance for Service and Maintenance Personnel. EPA 560/5-85-018.

Asbestos Waste Management Guidance. EPA 530-SW-85-007.

Asbestos Fact Book. EPA Office of Public Affairs. Asbestos in Buildings. Simplified Sampling Scheme for Friable Surfacing Materials.

Commercial Laboratories with Polarized Light Microscopy Capabilities for bulk asbestos identification.

A Guide to Respiratory Protection for the Asbestos Abatement Industry. EPA-560-OPTS-86-001.

NOTICES: CRITICAL

U.S. ENVIRONMENTAL PROTECTION AGENCY

*Send Written Notification* as required by USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M) to the regional Asbestos NESHAPS Contact at least 10 days prior to beginning any work on asbestos-containing materials.

The Consulting Agency will submit all DSHS notifications for the projects accomplished under these contract documents.

Send to: Texas Department of State Health Services (DSHS)
The Texas Department of Health
1100 West 49th Street
Austin, Texas 78756
(512) 834-6600

STATE AND LOCAL AGENCIES:

*Notification:* The project notification and any necessary amendments will be submitted to the Texas Department of Health on the most current "Demolition/Renovation Notification Form". By North American Analytical Labs, Incorporated.

*Send written Notification* as required to the Texas Department of Health and as required by any local regulations prior to beginning any work on asbestos-containing materials.

PERMITS:

*Permits:* An annual "Asbestos Transporter License", issued by The Texas Department of State Health Services, Division of Occupational Health, specifically for the transportation of asbestos-containing materials, is required for transporting waste asbestos-containing materials to a disposal site. This license must be presented prior to the loading of any asbestos containing waste for transport to a federal and state approved landfill

LICENSES:

*Licenses:* Maintain current licenses as required by applicable federal, state, and local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this contract. The contractor will submit the following Texas Department of Health licenses; Unrestricted Asbestos Abatement Contractors , Unrestricted Asbestos Contractor Supervisor, Worker Registrations, & Unrestricted Asbestos Waste Transporter.

*Posting and Filing of Regulations:* Maintain two (2) copies of applicable federal, state and local regulations above. Post one copy of each at the job site. Keep on file in contractor's office one copy of each.

SUBMITTALS:

*Before Start of Work:* Submit the following to the Project Administrator for review. No work shall begin until these submittals until all the submittals have been submitted and reviewed.

*Training Certificates:* Submit 3 copies of current valid certificates for all personnel

working on any project performed under these contract documents as required by Federal, State and Local regulations.

*Licenses:* Submit 3 copies of current valid licenses for all personnel working on any project performed under these contract documents.

*Permits:* All State and Local licenses and permits necessary to carry out the work of this contract.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION - II. A. 4.

1.5. SCHEDULES, REPORTS, ASBESTOS ABATEMENT

II. A. 5. - SCHEDULES, REPORTS, PAYMENTS - ASBESTOS ABATEMENT

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specifications divisions, apply to work of this division.

COORDINATION:

Coordinate both the listing and timing of reports and activities required by provisions of this section and other sections, so as to provide consistency and logical coordination between the reports. Maintain coordination and correlation between separate reports by updating at monthly or shorter time intervals. Make appropriate distribution of each report and updated report to all parties involved in the work including the Owner's Representative and Owner. In particular provide close coordination of the progress schedule, schedule of values, listing of subcontracts, schedule of submittals, progress reports, and payment requests.

PROGRESS SCHEDULE:

SCHEDULES:

*At pre-work conference*, submit proposed detailed schedule including work dates, work shift time, number of employees, dates of start and completion including dates of preparation work, removals and final inspection dates.

PROGRESS MEETINGS:

*General:* In addition to specific coordination and pre-installation meetings for each element of work, and other regular project meetings held for other purpose, Owner's Representative will hold general progress meetings as required. Each entity then involved in planning, coordination or performance of work will be properly represented at each meeting.

PRE-CONSTRUCTION CONFERENCE:

*An initial meeting recognized as "Pre-Work Conference":* Prior to start of any work, meet at project site, with General Superintendent, Owner, Owner's Representative, Project Administrator, and other entities concerned with asbestos abatement work. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to all participants prior to convening Pre-Work Conference.

This is an organizational meeting to review responsibilities and personnel assignments, to locate the containment and decontamination areas; and temporary facilities including power, light, water etc. The Project Administrator will review the forms and submittals required during the Project and *Pre-Work submittals will be provided by the Contractor to the Project Administrator at this meeting.*

REPORTING:

*Daily log:* Maintain within the Clean Room of the Decontamination Unit a daily log documenting the dates and time of but not limited to the following items:

- Meetings; purpose, attendees, discussion (brief)
- Visitations; authorized and unauthorized
- Personnel, by name, entering and leaving the work area
- Special or unusual events, i.e. Barrier breaching, Equipment failure
- Air Monitoring tests and test results
- Documentation with confirmation signature of Project Administrator of the following:

    - Inspection of work area preparation prior to start of
    - Removal and daily thereafter.
    - Removal of any polyethylene barriers
    - Contractors inspections prior to encapsulation
    - Removal of waste materials from work area
    - Decontamination of equipment (list items)
    - Contractors final inspection/final air test analysis.

Provide two copies of this log at final closeout of project for use by the Owner.

SCHEDULE OF VALUES:

See front end contract documents.

PAYMENT TO CONTRACTOR:

*General:* Payment shall be per Division 0 Procurement & Contracting Requirements.

The Owner, before making any payment, may require the Contractor to furnish receipts, waivers of lien, or other evidence of payment from all persons performing work and supplying materials to the Contractor. The Owner may, however, make payment without requiring the furnishing of such receipts, waivers or other such evidence of payment. These provisions shall be construed solely for the benefit of the Owner and shall not require the Owner to determine or adjust any claims or disputes between the Contractor and his subcontractors or materials men, or to withhold any moneys for their protection unless the Owner elects to do so. The failure or refusal of the Owner to withhold any moneys from the Contractor shall in no way impair the obligations of any surety or sureties under any bond or bonds furnished under this contract.

*Waivers of Lien:* If required by Owner, for the payment application, submit waivers of lien from every entity (including Contractor) who could lawfully and possibly file a lien arising out of the Contract and related to work covered by the payment. Submit partial waivers for the amount requested prior to deduction or retainage on each item. When the application shows completion of an item, submit final or full waivers. Owner reserves the right to designate which entities involved in the work must submit waivers.

*Waiver Delays:* Each progress payment must be submitted with Contractor's waiver for period of construction covered by application. At the Contractor's option, each progress payment may be submitted with waivers from the subcontractors, or sub-contractors and suppliers for the previous period of construction covered by previous application. The final payment application must be submitted together with or preceded by final or complete waivers (if required by Owner) from every entity involved with performance of the work covered by the payment request.

*Waiver Forms:* Submit waivers on forms, and executed in a manner, acceptable to Owner.

*Payment Application Times:* The "date" for "payment" is as indicated on the executed Purchase Order, or, if none is indicated therein; it is within 31 days after the completion of Work. The period of Work covered by the payment request is the period indicated in the Project Manual.

*Application Preparation:* Except as otherwise indicated, complete every entry provided for on the form, including notarization and execution by authorized persons Incomplete applications will be returned by Owner without action. Entries must match current progress schedule and report. Listing must include amounts of change orders issued

prior to last day of the "period of construction" covered by application.

*Final Payment Application:* the administrative actions and submittals which must precede or coincide with submittal of contractor's final payment application can be summarized as follows, but not necessarily by way of limitation. The Contractor must submit 3 copies, loose leaf clipped, of all the project documentation to the Project Administrator. This documentation must be verified as complete prior to recommending payment to the Contractor.

Submittal of all required documentation.

Completion of project closeout requirements.

Assurance, satisfactory to Owner, that unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.

Transmittal of required project Work records to owner.

Landfill receipts for all asbestos-containing material.

Proof, satisfactory to Owner, that taxes, fees and similar obligations of Contractor have been paid.

Removal of temporary facilities, services, surplus materials, rubbish and similar elements.

Change over of door locks and or keys and other Contractor's access provisions to Owner's property.

Consent of surety for final payment.

*Application transmittal:* Submit 3 executed copies of each payment application, one copy of which is completed with waivers of lien and similar attachments. Transmit each copy with a transmittal form listing those attachments, and recording appropriate information related to application in a manner acceptable to Owner. Transmit to Owner by means ensuring receipt within 24 hours.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION - II. A. 5.

1.6. SHOP DRAWINGS, PRODUCT DATA & SAMPLES

## II. A. 6. - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

### PART 1 - GENERAL

### RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

### DESCRIPTION OF REQUIREMENTS:

*General:* This section specifies procedural requirements for non-administrative submittals including shop drawings, product data, samples and other miscellaneous work-related submittals. Shop drawings, product data, samples and other work-related submittals are required to amplify, expand and coordinate the information contained in the Contract Documents.

Refer to other Division-1 sections and other contract documents for specifications on administrative, non-work-related submittals. Such submittals include, but are not limited to the following items:

Permits.
Payment applications.
Performance and payment bonds.
Insurance certificates.
Inspection and test reports.
Progress reports.
Listing of subcontractors & suppliers
Employee safety plan

*Shop Drawings:* (NOT APPLICABLE)

Product data includes standard printed information or manufactured products that has not been specially-prepared for this project, including but not limited to the following items:

Manufacturer's product specifications and installation instruction
Standard color charts.
Standard product operating and maintenance manuals.

*Samples* are physical examples of work included in these Specifications.

*Miscellaneous submittals* are work-related, non-administrative submittals that do not fit in the three previous categories, including, but not limited to the following:

Specially-prepared and standard printed warranties.
Maintenance agreements.
Workmanship bonds.
Operating and maintenance manuals.
Keys and other security protection devices.

SUBMITTAL PROCEDURES:

*General:* Refer to the General Conditions for basic procedures for submittal handling:

*Coordination:* Coordinate the preparation and processing of submittals with the performance of the work. Coordinate each separate submittal with other submittals and related activities such as testing, purchasing, fabrication, delivery and similar activities that require sequential activity.

Coordinate the submittal of different units of inter-related work so that one submittal will not be delayed by the Owner's Representative's need to review a related submittal. The Owner's Representative reserves the right to withhold action on any submittal requiring coordination with other submittals until related submittals are received.

*Scheduling:* In each appropriate administrative submittal, such as the progress schedule, show the principal work-related submittals and time requirements for coordination of submittal activity with related work.

*Listing:* Prepare a separate listing showing principal work-related submittals and their initial submittal dates as required for coordination of the work. Organize the listing by the related specification number sequence. Submit the listing within 45 days of the date of commencement of the work.

*Coordination of Submittal Times*: To be determined.

*Submittal Transmittal:* (NOT APPLICABLE)

*Transmittal Form:* Prepare a draft of a transmittal form and submit it to the Owner's Representative for acceptance. Provide on the form places for the following information as applicable and per Division 0 Procurement & Contracting Requirements:

Project name.
Date
To:
From:
Names of subcontractor, manufacturer and supplier
References
Category and type of submittal
Submittal purpose and description
Submittal and Transmittal distribution records

Signature of transmitter

Contractor's certification stating that the information submitted complies with the requirements of the Contract Documents, with a place for the Contractor's signature.

Record relevant information and requests for data on the transmittal form. On the transmittal form, or on a separate sheet attached to the form, record deviations from the requirements of the Contract Documents, if any, including minor variations and limitations.

SPECIFIC SUBMITTAL REQUIREMENTS:

*General:* Specific submittal requirements for individual units of work are specified in the applicable specification section. Except as otherwise indicated in the individual specifications sections, comply with the requirements specified herein for each type of submittal.

Where it is necessary to provide intermediate submittals between the initial and final submittals, provide and process intermediate submittal in the same manner as initial submittals.

*Shop Drawings:* Information required on shop drawings includes dimensions, identification of specific products and materials which are included in the work, compliance with specified standards and notations of coordination requirements with other work. Provide special notation of dimensions that have been established by field measurement. Highlight, encircle or otherwise indicate deviations from the Contract Documents on the shop drawings.

*Coordination Drawings:* Provide continuous drawings where required for the integration of the work, including work first shown in detail on shop drawings or product data. Show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination drawings are considered shop drawings and must be definitive in nature.

Do not permit shop drawings copies to be used in connection with the work without an appropriate final "Action" marking by the Owner's Representative.

*Preparation:* Submit newly prepared information, drawn to accurate scale on sheets not less than 8-1/2" x 11"; except for actual pattern or template type drawings, the maximum sheet size shall not exceed 36" x 48". Indicate the name of the firm that prepared each shop drawing and provide appropriate project identification in the title block. Provide a space not less that 20 sq. in. beside the title block for marking the record of the review process and the Owner's Representative's "Action" marking.

Do not reproduce contract documents or copy standard printed information as the basis of shop drawings.

*Product Data:* General information required specifically as product data includes manufacturer's standard printed recommendations for application and use, compliance with recognized standards of trade associations and testing agencies, and the application of their labels and seals (if any), special notation of dimensions which have been verified by way of field measurement, and special coordination requirements for interfacing the material, product or system with other work.

Whereas manufacturer, fabricator or similar entity shown on the product data submittal is a firm listed on the Owner's preferred vendor listing, mark the Owner's Representative's copies with "Owner's List" notation.

*Preparation:* Collect required product data into a single submittal for each units of work or system. Mark each copy to show which choices and options are applicable to the project. Where project data has been printed to include information on several similar products, some of which are not required for use on the project, or are not included on this submittal, clearly mark the copies to indicate who such information is not applicable to.

*Submittals:* Product data submittal is required for information and record and to determine that the products, materials and systems comply with the provisions of the contract documents. Therefore, the initial submittal is also the final submittal, except where the Owner's Representative observes that there is non-compliance with the provisions of the contract documents and returns the submittal promptly to the Contractor marked with the appropriate "Action."

Provide a preliminary single-copy submittal where required, for selection of options by the Owner's Representative.

*Initial Submittal:* Except as otherwise indicated in individual sections of these specifications, submit 2 copies of each required product data submittal, plus 2 additional copies where required for maintenance manuals. The Owner's Representative will retain one copy, and will returned the other marked with "Action" and corrections or modifications as required.

Do not submit product data or allow its use on the project, until compliance with the requirements of the contract documents has been confirmed by the Contractor.

*Final Distribution:* Furnish copies of product data to subcontractors, suppliers, fabricators, manufacturers, installers, governing authorities and others as required for proper performance of the work. Show distribution on transmittal form.

*Installation Copy:* Do not proceed with installation of materials, products and systems until a copy of product data applicable to the installation is in the possession of the installer. Do not permit the use of unmarked copies of product data in connection with the performance of the work.

*Samples:* Submit samples for the Owner's Representative's visual review of general generic kind, color, pattern, and texture, and for a final check of the coordination of these characteristics with other related elements of the work. Samples are also submitted for quality control comparison of these characteristics between the final sample submittal and the actual work as it is delivered and installed.

Refer to individual work sections of these specifications for additional sample requirements, which may be intended for examination or testing of additional characteristics. Compliance with other required characteristics is the exclusive responsibility of the Contractor; such compliance is not considered in the Owner's Representative's review and "Action" indication on sample submittals.

Documentation required specifically for sample submittals includes a generic description of the sample, the sample source or the product name or manufacturer, compliance with governing regulations and recognized standards. In addition, indicate limitations in terms of availability, sizes, delivery time, and similar limiting characteristics.

Where the manufacturer, fabricator, or similar producer of work represented by a sample submittal is a firm listed on the Owner's preferred vendor listing, mark the sample documentation with "Owner's List" notation.

*Submittal:* At the Contractor's option and depending upon the nature of the anticipated response from the Owner's Representative, the initial submittal of samples may be either a preliminary submittal or a final submittal.

*Preliminary submittal,* of a single set of samples, is required where requirement indicate the Owner's Representative's selection of color, pattern, texture or similar characteristics from a manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with the Owner's Representative's "Action" marking.

*Warranties:* Refer to this division "Products and Substitutions" for specific general requirements on warranties, product bonds, workmanship bonds and maintenance agreement. In addition to copies desired for the Contractor's use, furnish two executed copies of such warranties, bonds or agreements. Provide two additional copies where required for maintenance manuals.

*Survey Data:* Refer to the "Project Coordination" section for specific general requirements on property surveys, field measurements, quantitative records of actual work, damage surveys and similar data required by the individual sections of these specifications. None of the specified copies will be returned.

*Records of Actual Work:* Furnish four copies of records of actual work, one of which will be returned for inclusion in the record document as specified in section "Project

Closeout".

*Standards:* Where submittals of a copy of standards is indicated, and except where copies of standards are specified as an integral part of a "Product Data" submittal, submit a single copy of standards for the Owner's Representative's use. Where workmanship, whether at the project site or elsewhere is governed by a standard, furnish additional copies of the standard to fabricators, installers and others involved in the performance of the work.

*Closeout Submittals:* Refer to the "Project Closeout" section and to individual sections of these specifications for specific submittal requirements of project closeout information, materials, tools, and similar items.

*Record Documents:* Furnish set of original documents as maintained on the project site. Along with original marked-up record drawings provide two photographic copies of marked-up drawings, which, at the Contractor's option, may be reduced to not less than half size.

*Operating and Maintenance Data:* Furnish two bound copies of operating data and maintenance manuals.

*Materials and Tools:* Refer to individual divisions of these specifications for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

*General Distribution:* Provide additional distribution of submittals to contractors, suppliers, fabricators, installers, governing authorities, and others as necessary for the proper performance of the work. Include such additional copies of submittals in the transmittal to the Owner's Representative where the submittals are required to receive "Action" marking before final distribution. Record distributions on transmittal forms.

OWNER'S REPRESENTATIVE'S ACTION:

*General:* Except for submittals for the record and similar purposes, where action and return on submittals is required or requested, the Owner's Representative will review each submittal, mark with appropriate "Action", and where possible return within a reasonable time of receipt. Where the submittal must be held for coordination the Owner's Representative will so advise the Contractor without delay per Division 0 Procurement & Contracting Requirements.

*Final Unrestricted Release:* Where the submittals are marked as follows, the work covered by the submittal may proceed provided it complies with the requirements of the contract documents; acceptance of the work will depend on that compliance per Division 0 Procurement & Contracting Requirements.

*Returned for Resubmittal:* When the submittal is marked as follows, do not proceed

with the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise the submittal or prepare a new submittal in accordance with the Owner's Representative's notations stating the reasons for returning the submittal; resubmit the submittal without delay. Repeat if necessary to obtain a different action marking. Do not permit submittals with the following marking to be used at the project site, or elsewhere where work is in progress per Division 0 Procurement & Contracting Requirements.

*Other Action:* Where the submittal is returned, marked with the Owner's Representative's explanation, for special processing or other Contractor activity, or is primarily for information or record purposes, the submittal will be marked per Division 0 Procurement & Contracting Requirements:

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION - II. A. 6.

## 1.7. TEST LABORATORY SERVICES

II. A. 7. - AIR MONITORING-TEST LABORATORY SERVICES

PART 1 - GENERAL

DESCRIPTION OF THE WORK

This section describes air monitoring carried out by the owners Consultant/Air Monitoring Technician to verify that the building beyond the work area and the outside environment remain uncontaminated. This section also sets forth airborne fiber levels both inside and outside the work area as action levels, and describes the action required by the Contractor if an action level is met or exceeded.

Air monitoring required by OSHA is Contractor's responsibility and is not covered in this section.

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specifications sections, apply to work of this section.

*Air Monitoring:* Work area clearance is described in II.A.17. Work Area Clearance.

*Work Area Isolation:* The purpose of the Owner's Consulting Agency/Air Monitoring Technician will be to detect faults in the work area isolation such as:

Contamination of the building outside of the work area with airborne asbestos fibers,

Failure of filtration or rupture in the negative pressure system,

Contamination of the exterior of the building with airborne asbestos fibers.

Should any of the above occur the contractor shall immediately cease asbestos abatement activities until the fault is corrected. Work shall not re-commence until authorized by the Owner's Representative.

*Work Area Airborne Fiber Count:* The Owner's Consultant/Air Monitoring Technician will monitor airborne fiber counts in the work area. The purpose of this air monitoring will be to detect airborne fiber counts that may significantly challenge the ability of the work area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers.

Work area clearance to determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to .010 fibers per cubic centimeter (f/cc) or below as required by State, Federal and OSHA regulations. This will be accomplished by means of Phase Contrast Microscopy (PCM). In the event the owner wishes to utilize Transmission Electron Microscope (TEM) for clearances the level of clearance will be at 70 structures per millimeter squared (S/mm2).

AIRBORNE FIBER COUNTS

Inside Work Area: Maintain an average airborne count in the work area of less than 0.5 fibers per cubic centimeter. If the fiber counts rise above this figure for any sample taken, revise work procedures to lower fiber counts. If the Time Weighted Average (TWA) fiber count for any work shift or 8 hour period exceeds 0.1 fibers per cubic centimeter, stop all work, leave negative air system in operation and notify Project Administrator/Consultant. Do not re-commence work until authorized in writing by the Project Administrator/Consultant.

If airborne fiber counts exceeds 1.0 fibers per cubic centimeter for any period of time cease all work until fiber counts fall below 0.5 fibers per cubic centimeter and notify the Project Administrator/Consultant. Do not re-commence work until authorized in writing by the Project Administrator/Consultant.

*Outside Work Area:* If any pair sample taken outside of the work area exceeds the projects established baseline , immediately and automatically stop all work. If this air sample was taken inside the building and outside of critical barriers around the work area, immediately erect new critical barriers as set forth in II.A.10, Temporary Enclosures to isolate the affected area from the balance of the building. Erect Critical Barriers at the next existing structural isolation of the involved space (i.e.: wall, ceiling, floor).

*Respiratory protection:* as set forth in II.A.12. Respiratory Protection shall be worn in affected area until area is cleared for re-occupancy in accordance with II.A.17. Work Area Clearance.

*Leave Critical Barriers:* in place until completion of work and insure that the operation of the negative pressure system in the work area results in a flow of air from the balance of the building into the affected area.

If the exit from the clean room of the personnel decontamination unit enters the affected area, establish a temporary decontamination facility consisting of a Shower Room and Changing Room as set forth in Division II.A.13 Decontamination Units. After cleaning and decontamination of the affected area remove the Shower Room and leave the Changing Room in place as an air lock.

*After certification:* of visual inspection in the work area, remove critical barriers separating the work area from the affected area. Final air samples will be taken within the entire area as set for in the Division II.A.17 Work Area Clearance.

*Fibers Counted:* The following procedure will be used to resolve any disputes regarding fiber types when a project has been stopped due to excessive airborne fiber counts. "Airborne Fibers" referred to above include all fibers regardless of composition as counted in the NIOSH 7400 Procedures. If work has stopped due to high airborne fiber counts, air samples will be secured in the same area by the Owners Project Administrator /Consultant for analysis by electron microscopy. "Airborne Fibers" counted in samples analyzed by Transmission Electron Microscopy shall be only asbestos fibers, but of any diameter and length. Subsequent to analysis by electron microscopy the number of "Airborne Fibers" shall be determined by multiplying the number of fibers, regardless of composition, counted by the NIOSH 7400 procedure by a number equal to asbestos fibers counted divided by all fibers counted in the electron microscopy analysis.

*Effect on Contract Sum:* If electron microscopy is used to arrive at the basis for determining "Airborne Fiber" counts in accordance with the above paragraph, and if the average of airborne asbestos fibers in all samples taken exceeds 0.5 fibers per cubic centimeter, or if any one sample exceeds 1.0 fibers per cubic centimeter, then the cost of such analysis will be borne by the Contractor, at no additional cost to the Owner or Project Administrator/Consultant.

ANALYTICAL METHODS:

The following methods will be used by the Air Monitoring Technician in analyzing filters used to collect air samples.

Cellulose ester filters will be analyzed using procedures specified for the NIOSH 7400 method.

Mixed cellulose ester or polycarbonate filters will be analyzed using the Level II analysis per EPA Provisional Method and Update (USEPA 1977, Yamate 1984). This analysis will be carried out at a laboratory off the job site.

SAMPLE VOLUMES:

General: The number and volume of air samples taken by the Owner's Consultant/Project Administrator or Air Monitoring Technician will be in accordance with the following schedule. Sample volumes given may vary depending upon the discretion of the Project Administrator.

SCHEDULE OF AIR SAMPLES:
Before Start of Work:
The air monitor will secure the following Area Air Samples to establish a base line before start of work. The counting method will be NIOSH 7400 A rules. Sample media utilized will be Mixed Cellulose Ester (MCE) in 25mm cassettes. Five samples will be collected per floor to establish baseline levels.

| Location (Area Samples) | Recommended Number of | Media | Filter Rate Quantification Samples | Limit of Volume Fibers/cc | LPM (Liters) |
|---|---|---|---|---|---|
| Each Work Area | 5 | MCE | 0.004 | 1250 to 3000 | 2-10 |
| Outside Each Work Area | 0 | MCE | 0.004 | 1250 to 3000 | 2-8 |
| Outside Building | 0 | MCE | 0.004 | 1250 to 3000 | 2-8 |
| Field Blank | 2 | MCE | 0 | 0 | 0 |
| Sealed Blank box | 0 0 | MCE | 0 | One sample analyzed per | |

* One (1) area sample per every 5000 square feet of containment.
*Base Line:* is a level expressed in fibers per cubic centimeter which is ten percent greater than the largest of the following:

* The fiber level before any abatement commences;
* Average of the samples collected on cellulose ester filters outside each work area;
* Average of the samples collected on cellulose ester filters outside the building;

*Daily:*
From start of work, through project decontamination, the air monitor will take the following area samples on a per shift basis utilizing Mixed Cellulose Ester Filters (25mm cassette) and the NIOSH 7400 Method A rules.

| Location (Area Samples) | Recommended Number of | Media | Filter Rate Quantification Samples | Limit of Volume Fibers/cc | LPM (Liters) |
|---|---|---|---|---|---|
| Inside Work Area | 2 | MCE | 0.01 | 600 | 2-10 |
| Outside Work Area at Critical Barriers | 1 | MCE | 0.01 | 1250 | 2-8 |
| Outside Building | 1 | MCE | 0.01 | 1250 | 2-5 |
| Outside Decon | 1 | MCE | 0.01 | 1250 | 2-8 |
| Output Negative Pressure System | 1 | MCE | 0.01 | 1250 | 2-8 |
| Personals Abatement personnel | 25% of | MCE | 0.01 | 240 | .5-2.5 |
| *Excursion Sample*: Abatement personnel | 25% of | MCE | 0.10 | 60 | .5-2.5 |
| Field Blanks | 2 | MCE | N/A | 0 | 0 |

If airborne fiber counts exceed allowed limits additional samples will be taken as necessary to monitor fiber levels. If airborne fiber counts routinely exceed allowable limits, the Contractor will be required to provide a fibrous aerosol monitor (FAM) to continuously monitor fiber levels.

LABORATORY TESTING:

The services of a testing laboratory will be employed by the Owner to perform laboratory analysis of the air samples. A microscope and technician will be setup at the job site, or samples will be sent daily by overnight mail, so that verbal reports on air samples can be obtained with 24 hours. A complete record, certified by the testing laboratory, of all air monitoring tests and results will be furnished to the Owner's Representative, the Owner and the Contractor. Samples will be retained by the testing laboratory until project completion at which time they will be transported to the owner for retention unless other arrangements are made in writing.

*Written Reports:* All air monitoring tests will available for review on the job site.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

ADDITIONAL TESTING:

The Contractor may conduct his own personal air monitoring and laboratory testing. Provided that the Contractor has personnel licensed by the state of Texas to collect air samples and the Contractor has a license to analyze the PCM samples. If the

Contractor has these licenses they must be submitted to the Owner's Consultant/Project Administrator for approval to work on this project. If the Contractor elects performs his/her own sample collection and testing the cost of this collection and testing must be included in the Contractors submitted price to perform the work. No additional money will be paid to the Contractor by the Owner for such services.

PERSONAL MONITORING:

The Contractor will perform personal air monitoring on a minimum of 25% of the work force on a per shift/work area basis as required to meet OSHA Requirements for maintenance of Time Weighted Average (TWA) fiber counts for types of respiratory protection provided. Should the contractor employ a third party air monitoring firm a copy of the firms "Standard Operating Procedures Manual" must be submitted prior to commencement of work. The air monitoring firm must submit copies of all applicable insurance's and a copy of the last Proficiency Analytical Testing (PAT) round showing at least a 75% compliance score. The Contractors third party air monitoring firm must possess a current Texas PCM Laboratory license. The Contractors air monitoring technician (AMT) must possess a current Texas AMT license and a current asbestos physical. All results must be posted on site by 7:00am the next day after collection.

SCHEDULE OF AIR SAMPLES:

*Final clearance: (PCM)*

The air monitor will secure the following Area Air Samples to establish a clearance of the containment after completion of final cleaning. The method of collection will be NIOSH 7400 . Sample media utilized will be Mixed Cellulose Ester Filter (MCEF) in 25mm cassettes. The method of analysis will be Phase Contrast Microscopy (PCM). Only a DSHS licensed laboratory can provide analysis of the clearance samples.

| Location (Area Samples) | Recommended Rate of | Number Media Samples | Filter Quantifications Fibers/cc | Limit of Volume (Liters) | LPM |
|---|---|---|---|---|---|
| Inside Work Area | 5 | MCE 0.005 | 1250 to3000 | 2-10 | |
| Outside Each Work Area | 0 | MCE 0.005 | 1250 to3000 | 2-10 | |
| Outside Building | 0 | MCE 0.005 | 1250 to3000 | 2-10 | |
| Field Blank | 2 | MCE 0 | 0 | 0 | |
| Sealed Blank | 0 | MCE 0 | One sample analyzed per box | | 0 |

A copy of this sampling schedule must accompany the PCM sample set collected on this project.

*Final clearance:* *(TEM)*

The air monitor will secure the following Area Air Samples to establish a clearance of the containment after completion of final cleaning. The method of collection will be NIOSH 7400 . Sample media utilized will be Mixed Cellulose Ester Filter (MCEF) in 25mm cassettes. The method of analysis will be Phase Contrast Microscopy (PCM), only a DSHS licensed laboratory can provide analysis of the clearance samples.

| Location (Area Samples) | Recommended Rate of | Number Media | Filter Quantifications Samples | Limit of Volume Fibers/cc | LPM (Liters) |
|---|---|---|---|---|---|
| Inside Work Area | 250to3000 | 5 2-10 | MCE | 0.005 | |
| Outside Each Work Area | 1250to3000 | 0 2-10 | MCE | 0.005 | |
| Outside Building | 1250to3000 | 5 2-10 | MCE | 0.005 | |
| Field Blank | 0 | 2 | MCE | 0 | 0 |
| Sealed Blank | 0 | 1 | MCE | 0 | 0 |

END OF SECTION - II. A. 7.

PART 2 - PRODUCTS

2.1. TEMPORARY FACILITIES - ASBESTOS ABATEMENT

II. A. 8. - TEMPORARY FACILITIES - ASBESTOS ABATEMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

*General:* Provide temporary connection to existing building utilities or provide temporary facilities as required herein or as necessary to carry out the work.

PART 2 - PRODUCTS

MATERIALS AND EQUIPMENT:

*General:* Provide new or used materials and equipment that are undamaged and in serviceable condition. Provide only materials and equipment that are recognized as being suitable for the intended use, by compliance with appropriate standards.

SCAFFOLDING:

Provide all scaffolding(if needed),ladders and/or staging, etc. as necessary to accomplish the work of this contract. Scaffolding may be of suspension type; or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding shall comply with all applicable OSHA provisions.

Equip rungs of all wooded ladders, etc. with an abrasive non-slip surface.

Provide a nonskid surface on all scaffold surfaces subject to foot traffic.

WATER SERVICE:

*Temporary Water Service Connection:* All Contractor connections to the Owner's water system shall include backflow protection. Valves shall be temperature and pressure rated for operation of the temperatures and pressures encountered. After completion of use, connections and fittings shall be removed without damage or alteration to existing water piping and equipment.

Leaking or dripping valves shall be piped to the nearest drain or located over an existing

sink or garage where water will not damage existing finish or equipment. All water shut-off valves will be located outside the containment area. Contractor shall provide necessary connections at no expense to the Owner. Water shall be provided by the Owner.

*Water Hoses:* Employ heavy duty abrasion-resistant hoses with a pressure rating greater than the maximum pressure of the water distribution system to provide water into each work area and to each Decontamination Unit. Provide fittings as required to allow for connection to existing wall hydrants or spouts, as well as temporary water heating equipment, branch piping, showers, shut-off nozzles and equipment. All water pressure shall be released from all water hoses at the end of each shift and at any time the work area is unsupervised.

*Water Heater:* Provide UL rated 40 gallon electric hot water heater to supply hot water for the Decontamination Unit shower. Activate from 30 amp circuit breaker located within the Decontamination Unit sub panel. Provide with relief valve compatible with water heater operation; pipe relief valve down to drip pan on floor with type L copper. Drip pans shall consist of a 12" x 12" x 6" deep pan, made of 19 gauge galvanized steel, with handles. A 3-quart kitchen saucepan may be substituted for this purpose. Drip pan shall be securely fastened to the hot water heater with bailing wire or similar material. Wiring of the hot water heater shall be in compliance with NEMA, NECA, and UL standards.

*Hot Water:* The Contractor is responsible for providing hot water for each decontamination unit constructed under the performance of this project.

ELECTRICAL SERVICE:

*General:* Comply with applicable NEMA, NECA and UL standards and governing regulations for materials and layout of temporary electric service.

*Temporary Power:* Provide service to Decontamination Unit sub panel with minimum 60 amp, 2 pole circuit breaker or fused disconnect connected to a gas powered electrical generator. Sub panel and disconnect shall be sized and equipped to accommodate all electrical equipment required for completion of the work. Electricity will be the Contractor's expense. The Contractor will provide electrical power used. Requirements are to be coordinated at the Pre-work meeting.

*Voltage Differences:* Provide identification warning signs at power outlets which are other than 110-120 volt power. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110-120 volt plugs into higher voltage outlets. Dry type transformers shall be provided where required to provide voltages necessary for work operations.

*Ground Fault Protection:* Provide receptacle outlets equipped with groundfault circuit interrupters, reset button and pilot light, for plug-in connection of all power tools and

equipment.

*Electrical Power Cords:* Use only grounded extension cords; use "hard service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas of work.

*Lamps and Light Fixtures:* Provide general service incandescent lamps of wattage as required for adequate illumination. Protect lamps with guard cages or tempered glass enclosures, where fixtures are exposed to breakage by construction operations. Provide exterior fixtures where fixtures are exposed to the weather or moisture.

TEMPORARY HEAT:

*Heating Units:* Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the fuel being consumed. Use steam or hot water radiant heat where available, and where not available use electric resistant fin radiation supplied from a branch circuit with ground fault circuit interrupter. Under no circumstances shall forced air or fan type units be utilized inside a work area.

SELF CONTAINED TOILETS:

*Self Contained Toilet Units:* Provide single-occupant self-contained toilet units of the chemical type, properly vented and fully enclosed with a glass fiber reinforce polyester shell or similar non-absorbent material.

FIRST AID:

*First Aid Supplies:* Comply with governing regulations and recognized recommendations within the construction industry.

FIRE EXTINGUISHERS:

*Fire Extinguishers:* Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

PART 3 - EXECUTION

SCAFFOLDING:

During the erection and/or moving of scaffolding, care must be exercised so that the polyethylene floor covering is not damaged.

Clean as necessary debris from non slip surfaces.

At the completion of abatement work clean all construction aids within the work area, wrap in one layer of 6 mil polyethylene sheet and seal before removal from the work area.

INSTALLATION - GENERAL:

*General:* Use qualified tradesmen for installation of temporary services and facilities. Locate temporary services and facilities where they will serve the entire project adequately and result in minimum interference with the performance of the Work.

Relocate, modify and extend services and facilities as required during the course of work so as to accommodate the entire work of the project.

TELEPHONE SERVICE: N/A

WATER SERVICE:

*General:* Supply hot and cold water to the Decontamination Unit in accordance with II.A.13. In addition, water shall be supplied for the Contractor's use in normal work activities.

Maintain hose connections and outlet valves in leakproof condition. Where finish work below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize the possibility of water damage. Drain water promptly from pans as it accumulates.

ELECTRICAL SERVICE:

*General:* Provide a grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work during the construction period. Install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in every area of work.

*Power Distribution System:* Provide circuits of adequate size and proper characteristics for each use. In general, run wiring overhead, and rise vertically where wiring will be least exposed to damage from Work operations.

*Temporary Wiring:* in the work area shall be type UL non-metallic sheathed cable located overhead and exposed for surveillance. Do not wire temporary lighting with plain, exposed (insulated) electrical conductors. Provide liquid tight enclosures or boxes for wiring devices. Provide overload-protected disconnect switch for each temporary circuit located at the power distribution center.

For power hand tools and task lighting, provide a temporary 4-gang outlet at each decontamination unit, located in equipment room. Provide a separate 110-120 volt, 20 Amp circuit for each 4-gang outlet (4 outlets per circuit).

TEMPORARY LIGHTING:

Provide the following where natural lighting or existing building lighting does not meet the required light level:

> One 200-watt incandescent lamp per 1000 square feet of floor area, uniformly distributed, for general construction lighting, or equivalent illumination of a similar nature. In corridors and similar traffic areas provide one 100-watt incandescent lamp every 50 feet. In stairways and at ladder runs, provide one lamp minimum per story, located to illuminate each landing and flight. Provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight, general lighting, and portable plug-in task lighting.
>
> Provide lighting in the Decontamination Unit as required to supply a 50 foot candle minimum light level.

TEMPORARY HEAT:

*General:* Provide temporary heat where indicated or needed for performance of the Work.

Maintain a minimum temperature of 70 degrees F. where finished work has been installed.

Maintain a minimum temperature of 75 degrees F. in the shower of the Decontamination Unit.

Maintain a minimum temperature of 50 degrees F. in the work area at all times during and after removal work.

PROJECT ADMINISTRATOR'S FIELD OFFICE:

*Project Administrator's Field Office:* For projects over 10 working days in duration. The Owner will provide office space near the work area for the Project Administrator and Contractor's Superintendent. In addition to 1 desk and 3 chairs, furnish office with one 36" x 96" plan table, and one 24" x 48" worktable near electrical power outlet. Provide portable office or use a suitable room as designated by Owner and relocate or add equipment as required to meet the above requirements.

SANITARY FACILITIES:
Provide portable toilet facilities.

FIRE EXTINGUISHERS:

*Fire Extinguishers:* Comply with the applicable recommendations and laws of NFPA Standard 10 "Standard for Portable Fire Extinguishers" and TAHPR. Locate fire extinguishers where they are most convenient and effective for their intended purpose, but provide not less than one (1) C-5 extinguisher in each Work Area in Equipment Room and one outside Work Area in Clean Room.

END OF SECTION - II. A. 8.

2.2. NEGATIVE PRESSURE SYSTEM

II. A. 9. - NEGATIVE PRESSURE SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

SUBMITTALS

*Before Start of Work:* submit design of negative air system to the Project Administrator for review. Do not begin work until submittal is returned with the Owner's Representatives action stamp indicating that the submittal is returned for unrestricted use. Include in the submittal at a minimum:

Number of negative air machines required and the calculations necessary to determine the number of machines.

Description of projected air flow within work area and methods required to provide adequate air flow in all portions of the work area.

Pressure differential across work area enclosures anticipated.

Description of methods of testing for correct airflow and pressure differentials.

Manufacturer's product data on the machines to be used.

Location of the machines in the work space.

Method of supplying adequate power to the machines and designation of building electrical panel(s) which will be supplying the power.

Description of work practices to insure that airborne fibers travel downstream from workers.

Manufacturer's product data on equipment used to monitor pressure differential between inside and outside of work area.

Manufacturer's product data on auxiliary generator to be used.

Manufacturer's product data on auxiliary power switch to be used.

Schematic diagram of power and auxiliary power supply to negative air machines.

*QUALITY ASSURANCE:*

Monitor pressure differential across Decontamination Unit with a differential pressure meter equipped with a strip chart recorder. Meter shall be equipped with a warning buzzer which will sound if pressure differential drops below -0.02" of water column.

PART 2 - PRODUCTS

NEGATIVE AIR MACHINES:

*General:* Supply the required number of asbestos air filtration units to the site in accordance with these specifications. Each unit shall include the following:

*Cabinet:* Constructed of steel or other durable materials able to withstand damage from rough handling and transportation. The width of the cabinet should be less than 30 inches to fit through standard size doorways. Cabinet shall be factory sealed during use, transport, or maintenance. Access to and replacement of all air filters shall be from intake end. Unit shall be mounted on casters or wheels.

*Fans:* Rate capacity of fan according to usable air-moving capacity under actual operating conditions. Use centrifugal-type fan.

*HEPA Filters:* The final filter shall be the HEPA type. The filter media (folded into closely pleated panels) must be completely sealed on all edges with a structurally rigid frame.

A continuous rubber gasket shall be located between the filter and the filter housing to form a tight seal.

Each filter shall be individually tested and certified by the manufacturer to have an efficiency of not less than 99.97 percent when challenged with 0.3 in dioctylphthalate (DOP) particles. Testing shall be in accordance with Military Standard Number 282 and Army Instruction Manual 136-300-175A. Each filter shall bear a UL586 label to indicate ability to perform under specified conditions.

Each filter shall be marked with: the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.

*Pre filters:* which protect the final filter by removing the larger particles, are required to prolong the operating life of the HEPA filter. Two stages of prefiltration are required. The first stage prefilter shall be a low-efficiency type (e.g., for particles 10 microns and larger). The second stage (or intermediate) filter shall have a medium efficiency (e.g., effective for particles down to 5 microns). Prefilters and intermediate filters shall be installed either on or in the intake grid of the unit and held in place with special housings or clamps.

*Instrumentation:* Each unit shall be equipped with a Magnehelic gauge or manometer to measure the pressure drop across filters and indicate when filter become loaded and need to be changed. A table indicating the usable air-handling capacity for various static pressure readings on the Magnahelic gauge shall be affixed near the gauge for reference, or the Magnahelic reading indicating at what point the filters should be changed, noting Cubic Feet per Minute (CFM) air delivery at that point. Provide units equipped with an elapsed time meter to show the total accumulated hours of operation.

*Safety and Warning Devices:* The unit shall have an electrical (or mechanical) lockout to prevent fan from operating without a HEPA filter. Units shall be equipped with automatic shutdown system to stop fan in the event of a major rupture in the HEPA filter or blocked air discharge. Warning lights are required to indicate normal operation, too high a pressure drop across the filters (i.e., filter overloading), and too low of a pressure drop (i.e., major rupture in HEPA filter or obstructed discharge).

*Electrical components:* shall be approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL). Each unit shall be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet shall be grounded.

*Manufacturers:* Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Aerospace America, Inc. "Aero-Clean 2000"
900 Truman Parkway
P.O. Box 189
Bay City, Michigan 48707

Asbestos Control Technology, Inc. "Micro-Trap"
P.O. Box 183
Maple Shade, NJ 08052

Control Resource Systems, Inc. "Hog" 2000

670 Mariner Drive
Michigan City, Indiana 46360

Global Consumer Services, Inc. "Red Baron"
1721 N. Highland Avenue
Los Angeles, CA 90028

Tri-Dim Filter Corporation "ACCU-2M"
1431 West Lake Street
Chicago, Illinois 60607

PART 3 - EXECUTION

PRESSURE DIFFERENTIAL

Provide a fully operational negative air system within the work area maintaining continuously a pressure differential across work area enclosures of - 0.02 inches of water. Demonstrate to the Owner's Consultant/Project Administrator the pressure differential by use of a pressure differential meter or a manometer, before disturbance of any asbestos containing materials.

MONITORING

Continuously monitor and record the pressure differential between the work area and the building outside of the work area with a monitoring device incorporating a strip chart recorder.

PREPARATION OF THE WORK AREA:

*Determining the Ventilation Requirements:* Provide fully operational negative pressure systems supplying a minimum of one air change every 15 minutes. Determine the volume in cubic feet of the work area by multiplying floor area by ceiling height. Determine total ventilation requirements in cubic feet per minute (cfm) for the work area by dividing this volume by the air change rate.
*Ventilation Required (VR)= Volume of work area (cu. ft.)/15 min.*

*Determine Number of Units* needed to achieve 15 minute change rate by dividing the ventilation requirement (CFM) above by capacity of exhaust unit(s) used. Capacity of a unit for purposes of this section is the capacity in cubic feet per minute with fully loaded filters (Pressure differential which causes loaded filter warning light to come on) in the machines labeled operating characteristics. In the absence of a listed filter-loaded capacity, a figure of 80% of rated capacity will be used.

$$\text{Number of Units Needed} = \frac{\text{Ventilation Requirement}}{\text{Capacity of Neg-Air Machines with Loaded Filters (CFM)}}$$

Example: An area to be abated measures 30' x 30' giving us 900 square feet of floor space or area. The ceilings are 12' tall. Multiply 900 x 12' = 10,800 cubic feet of air that must be replaced every 15 minutes. We then divide 10,800 cubic feet by 15 (for the amount of minutes that the air is required to be exchanged) we get 720 this is our Ventilation Requirement (VR). A typical negative air machine or pressure differential unit moves 1500 cubic feet of air per minute (CFM). Therefore if we divide 720 by 1500 we get .48. This means that one negative air machine or pressure differential unit is more than sufficient to provide negative pressure within the enclosure.

Add one (1) additional unit as a backup in case of equipment failure or machine shut down for filter changing. In the event machines of differing sizes are in use, the back-up machine shall have the same capacity rating as the largest machine in use.

*Location of Exhaust Units:* Locate exhaust unit(s) so that makeup air enters work area primarily through decontamination facilities and traverses work area as much as possible. This may be accomplished by positioning the exhaust unit(s) at a maximum distance from the worker access opening or other makeup of air sources.

*Place End of Unit:* or its exhaust duct through an opening in the plastic barrier or wall covering. The plastic around the unit or duct shall then be sealed with tape.

*Vent to Outside of Building*, unless authorized in writing by the Owner's Consultant/Project Administrator. All openings created by the Contractor must be repaired after successful visual and air monitoring clearance.

*Supplemental Makeup Air Inlets:* Provide where required for proper air flow through the work space in location approved by the Owner's Representative by making openings in the plastic sheeting that allow air from outside into the work area. Locate auxiliary makeup air inlets as far as possible from the exhaust unit(s) (e.g., on an opposite wall), off the floor (preferably near the ceiling), and away from barriers that separate the work area from occupied clean areas. Cover with flaps to reseal automatically if the negative pressure system should shut down for any reason. Spray flap and around opening with spray adhesive so that flap seals if it closes. If makeup air is coming from a contaminated source or a potentially contaminated source, then it should pass through a HEPA filter before entering the work area. If this is done, supply air fans will be necessary to overcome the resistance of the HEPA filter. Use of a negative air machine may be a practical means of accomplishing this. Caution must be used to insure that the work area remains under negative pressure.

USE OF THE NEGATIVE PRESSURE SYSTEM:

*General:* Each unit shall be serviced by a dedicated minimum 115V-20A circuit with overload device tied into an existing building electrical panel which has sufficient spare capacity to accommodate the load of all negative pressure units connected. Dedication of an existing circuit may be accomplished by shutting down existing loads on the

circuit.

*Testing the System:* Test negative pressure system before any asbestos-containing material is wetted or removed. After the work area has been prepared, the decontamination facility set up, and the exhaust unit(s) installed, start the unit(s) (one at a time). Demonstrate operation and testing of negative pressure system to Owner's Consultant/Project Administrator.

*Demonstrate Operation* of the negative pressure system to the Owner's Consultant/Project Administrator will include, but not be limited to the following:

Plastic barriers and sheeting move slightly in toward work area.

Curtain of decontamination units move slightly in toward work area.

There is a noticeable movement of air through the decontamination unit. Use smoke tube to demonstrate air movement from Clean Room to Shower Room, from Shower Room to Equipment Room, and from Equipment Room to Work Area.

Use smoke tubes to demonstrate a positive motion of air across all areas in which work is to be performed.

Use a differential pressure meter or manometer to demonstrate a pressure difference of at least - 0.02 inches of water across every barrier separating the Work Area from the balance of the building or outside.

*Modify the Negative Pressure System* as necessary to successfully demonstrate the above.

Use of System During Abatement Operations:

Start exhaust units before beginning work (before any asbestos-containing material is disturbed). After abatement work has begun, run units continuously to maintain a constant negative pressure until decontamination of the work area is complete. Do not turn off units at the end of the work shift or when abatement operations temporarily stop.

Do not shut down negative air system during encapsulating procedures, unless authorized by the Owner's Consultant/Project Administrator in writing.

Start abatement work at a location farthest from the exhaust units and proceed toward them. If an electric power failure occurs, immediately stop all abatement work and do not resume until power is restored and exhaust units are operating again.

At completion of abatement work, allow exhaust units to run as specified under II. A. 9, to remove airborne fibers that may have been generated during abatement work and

cleanup and to purge the work area with clean makeup air. The units may be required to run for a longer time after decontamination, if dry or only partially wetted asbestos material was encountered during any abatement work.

Dismantling the System:

When a final inspection and the results of final air tests indicate that the area has been decontaminated, exhaust units may be removed from the work area. Before removal from the work area, remove and properly dispose of pre-filter, and seal intake to the machine with 6 mil polyethylene to prevent environmental contamination from the filters.

END OF SECTION - II.A.9.

2.3. TEMPORARY ENCLOSURE

II.A.10. - TEMPORARY ENCLOSURES

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

SUBMITTALS:

Submit Contingency Plans for safe evacuation of the work area in case of fire or injury.

PART 2 - PRODUCTS

*Polyethylene Sheet:* A single polyethylene film in the largest sheet size possible to minimize seams, 4.0 or 6.0 millimeters thick as indicated, clear, frosted, or black as required.

*Reinforce Polyethylene sheet:* Where plastic sheet is the only separation between the work area and building exterior, provide translucent, nylon reinforced, laminated Polyethylene. Provide largest size possible to minimize seams, 6.0 millimeters minimum thickness, frosted or black as required.

*Spray Plastic:* Provide spray plastic in aerosol cans or premised for spray application which is formulated to adhere gently to surfaces and remove cleanly by peeling off at the completion of the work.

*Duct Tape:* Provide duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to aggressively stick to sheet polyethylene.

*Spray Cement:* Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

*Plywood Sheeting:* 1/2 inch CD Grade

*Framing:* 2x4 inch framing

PART 3 - EXECUTION

SEQUENCE OF WORK:

Carry out work of this section sequentially. Complete each activity before proceeding to the next.

GENERAL:

*Work Area:* Is the location where asbestos-abatement work occurs. It is a variable of the extent of work of the contract. It may be a portion of a room, a single room, or a complex of rooms. A "work area" is considered contaminated during the work, and must be isolated from the balance of the building, and decontaminated at the completion of the asbestos-control work.

*Completely Isolate* the work area from other parts of the building so as to prevent asbestos-containing dust or debris from passing beyond the isolated area. Should the area beyond the work area(s) become contaminated with asbestos-containing dust or debris as a consequence of the work, clean those areas in accordance with the procedures indicated in Section II. A. 16. Perform all such required cleaning or decontamination at no additional cost to the Owner.

Place all tools, scaffolding, staging, etc. necessary for the work in the area to be isolated prior to erection of plastic sheeting temporary enclosure.

Remove all uncontaminated removable furniture, equipment, and/or supplies from the work area before commencing work, or completely cover with two (2) layers of polyethylene sheeting, at least 6 mil in thickness, securely taped in place with duct tape. Such furniture and equipment shall be considered outside the work area unless covering plastic or seal is broached.

Disable ventilating systems or any other system bringing air into or out of the work area. Disable system by disconnecting wires, removing circuit breakers, by lockable switch or other positive means that will prevent accidental premature restarting of equipment.

CONTROL ACCESS:

Permit Access to the work area only through the Decontamination Unit. All other means of access shall be closed off and sealed and warning signs displayed on the clean side

of the sealed access.

*Visual Barrier:* Where the work area is immediately adjacent to or within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 4 millimeter in thickness so that the work procedures are not visible to building occupants. Where this visual barrier would block natural light, substitute frosted sheet plastic in locations approved by the Owner's Representative.

*Physical Barrier:* Where the area adjacent to the work area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with nominal 2" x 4" wood studs 16" on center, securely anchored to prevent movement, covered with minimum 1/2" Plywood.

Provide Warning Signs at each visual and physical barrier reading as follows in both English and Spanish:

| Legend | Notation |
|---|---|
| KEEP OUT | 3" Sans Serif Gothic or Block |
| BEYOND THIS POINT | 1" Sans Serif Gothic or Block |
| ASBESTOS ABATEMENT WORK | 1" Sans Serif Gothic or Block |
| IN PROGRESS | 1" Sans Serif Gothic or Block |
| BREATHING ASBESTOS DUST MAY BE HAZARDOUS TO YOUR HEALTH | 14 Point Gothic |

ALTERNATE METHODS OF ENCLOSURE:

Alternate methods of containing the work area may be submitted to the Owner's Consultant/Project Administrator for approval in accordance with procedures set forth in section II. A. 10. Do not proceed with any such method(s) without the prior written approval.

RESPIRATORY AND WORKER PROTECTION:

Before proceeding beyond this point in providing Temporary Enclosures:

Provide Respiratory Protection per Section II. A. 10.

Provide Worker Protection per Section II. A. 11.

CRITICAL BARRIERS:

Completely separate the work area from other portions of the building, and the outside

by sheet plastic barriers at least 6 mil in thickness, or by sealing with duct tape.

Individually seal all ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, convectors and speakers, and other openings into the work area with duct tape alone or with polyethylene sheeting at least 6 mil in thickness, taped securely in place with duct tape. Maintain seal until all work including Project Decontamination is completed. Take care in sealing off lighting fixtures to avoid melting or burning of sheeting.

Provide Sheet Plastic barriers at least 6 mil in thickness as required to completely seal openings from the work area into adjacent areas. Seal the perimeter of all sheet plastic barriers with duct tape or spray cement.

Provide Decontamination Units per Section II. A. 13.

Provide Negative Pressure System per Section II. A. 9.

Clean housings and ducts of all overspray materials prior to erection of the Critical Barrier Polyethylene sheeting.

PRIMARY BARRIER:

Clean all contaminated furniture, equipment, and or supplies with a HEPA filtered vacuum cleaner or by wet cleaning, as specified in II.A.16, prior to being moved or covered. All equipment, furniture, etc. is to be deemed contaminated unless specifically declared as uncontaminated on the drawings or in writing by the Owner's Representative.

*Clean All Surfaces In Work Area* with a HEPA filtered vacuum or by wet wiping prior to the installation of any sheet plastic.

Remove all electrical and mechanical items, such as lighting fixtures, clocks, diffusers, registers, escutcheon plates, etc., which cover any part of the surface to be worked on with the work.

Remove all general construction items such as cabinets, casework, doors and window trim, moldings, ceilings, trim, etc., which cover the surface of the work as required to prevent interference with the work. Clean, decontaminate and reinstall all such materials, upon completion of all removal work with materials, finished, and workmanship to match existing installations before start of work.

*Enclose Work Areas* (after critical barriers are in place) with two (two) layers of plastic sheeting on floor and two (two) layers on all walls, or as otherwise directed on the contract drawings or in writing by the Owner's Representative.

*Cover Floor* of work area with two individual layers of clear polyethylene sheeting, each

at least 6 mil in thickness, turned up walls at least 12 inches. Both spray-glue and duct tape all seams in floor covering. Locate seams in top layer six feet from, or at right angles to, seams in bottom layer. Install sheeting so that top layer can be removed independently from bottom layer.

*Cover Sheet Plastic* in areas where scaffolding is to be used with a single layer of 1/2" CDX plywood or 1/4" tempered hardboard. Wrap edges and corners of each sheet with duct tape. At completion of abatement work wrap plywood or hardboard with two layers of 6 mil polyethylene and move to next work area or dispose of as an asbestos contaminated waste material in accordance with section 02084 of this specification.

*Cover all walls* in work area including "Critical Barrier" sheet plastic barriers with two (two) layers of polyethylene sheeting, at least 6 mil in thickness, mechanically supported and sealed with duct tape or spray-glue in the same manner as "Critical Barrier" sheet plastic barriers. Tape all joints including the joining with the floor covering with duct tape or as otherwise indicated on the contract documents or in writing by the Owner's Representative.

*Mechanically support sheet plastic* independently of duct tape or spray cement seals so that seals do not support the weight of the plastic. Following are acceptable methods of supporting sheet plastic barriers. Alternative support methods may be used if approved in writing by the Owner's Representative.

> Plywood squares 6" x 6" x 3/8" held in place with one 6d smooth masonry nail or electo-galvanized common nail driven through center of the plywood and duct tape on plastic so that plywood clamps plastic to the wall. Locate plywood squares at each end, corner and at maximum 4' on centers.
>
> Nylon or polypropylene rope minimum 1/4" in diameter suspended between supports securely fastened on either side of opening at maximum 1' below ceiling. Tighten rope so that is has 2" maximum dip. Drape plastic over rope from outside work area so that a 2' flap of plastic extends over rope into work area. Staple or wire plastic to itself 1" below rope at maximum 6" on centers to form a sheath over rope. Lift flap and seal to ceiling with duct tape or spray cement. Seal loop at bottom of flap with duct tape. Erect entire assemble so that it hangs vertically without a "shelf" upon which debris could collect.

*Stairs and Ramps:* Do not cover stairs or ramps with unsecured sheet plastic. Where stairs or ramps are covered with plastic, provide 3/4" exterior grade plywood treads securely held in place, over plastic. Do not cover rungs or rails with any type of protective materials.

DROP CLOTH

A layer of 6 mil poly will be used as a drop cloth to protect the floor polyethylene from debris generated by the asbestos abatement work as specified in the appropriate work

sections.

EXTENSION OF WORK AREA:

Extension of Work Area: If the enclosure barrier is breached in any manner that could allow the passage of asbestos debris or airborne fibers, then add affected area to the work area, enclose it as required by this section of the specification and decontaminate it as described in Section II. A. 13. Decontamination shall be performed at no additional cost to the Owner.

END OF SECTION - II.A.10.

2.4. WORKER PROTECTION - ASBESTOS ABATEMENT

II.A.11. - WORKER PROTECTION - ASBESTOS ABATEMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

This section describes the equipment and procedures required for protecting workers against asbestos contamination and other work place hazards except for respiratory protection.

RELATED WORK SPECIFIED ELSEWHERE:

*Respiratory Protection:* is specified in Section II.A.12.

WORKER TRAINING:

Train, in accordance with 29 CFR 1926, all worker in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. Include but do not limit the topics covered in the course of the following:

Methods of recognizing asbestos.

Health effects associated with asbestos.

Relationship between smoking and asbestos in producing lung cancer.

Nature of operations that could result in exposure to asbestos.

Importance of an instruction in the use of necessary protective controls, practices and procedures to minimize exposure including:

Engineering controls
Work Practices
Respirators
Housekeeping procedures
Hygiene facilities
Protective clothing
Decontamination procedures
Emergency procedures
Waste disposal procedures

Purpose, proper use, fitting, instructions, and limitations of respirators as required by 29 CFR 1910.134.

Appropriate work practices for the work

Requirements of medical surveillance program

Review of 29 CFR 1926

Negative air systems

Work practices including hands on or on-job training

Personal decontamination procedures

Air monitoring, personal and area

MEDICAL EXAMINATIONS:

Provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc or greater for an 8 hour time weighted average. In the absence of specific airborne fiber data provide medial examination for all workers who will enter the work area for any reason. Examination shall as a minimum meet OSHA requirements as set forth in 29 CFR 1926. In addition, provide an evaluation of the individuals ability to work in environments capable of producing heat stress in the worker.

SUBMITTALS:

*Before Start of Work:* Submit the following to the Owner's Representative for review. Do not start work until these submittals are returned with Owner's Representative's action stamp indicating that the submittal is returned for unrestricted use.

*Certificate Worker Acknowledgment:* Submit an original signed copy of the Certificate of Worker's Acknowledgment found at the end of this section, for each worker who is to be at the job site or enter the work area.

*Training Program:* Submit a course outline of the worker training course. Include date and time course was given, and name and title of teacher. Submittal shall be in the form of a letter signed and dated by the course instructor.

*Report from Medical Examination:* Conducted within last 12 months as part of compliance with OSHA medical surveillance requirements for each worker who is to enter the work area. Submit, at a minimum, for each worker the following:

Name and Social Security Number

Physicians Written Opinion from examining physician including at a minimum the following:

Whether worker has any detected medical conditions that would place the worker at an increased risk of material health impairment from exposure to asbestos.

Any recommended limitations on the worker or on the use of personal protective equipment such as respirators.

Statement that the worker has been informed by the physician of the results of the medical examination and of any medical conditions that may result from asbestos exposure.

Copy of information that was provided to physician in compliance with 29 CFR 1926.

Statement that worker is able to wear and use the type of respiratory protection proposed for the project, and is able to work safely in an environment capable of producing heat stress in the worker.

*Notarized Certifications:* Submit certification signed by an officer of the abatement contracting firm and notarized that exposure measurements, medical surveillance, and worker training records are being kept in conformance with 29 CFR 1926.

## PART 2 - EQUIPMENT

### PROTECTIVE COVERING:

*Coveralls:* Provide disposable full-body coveralls and disposable head covers, and require that they be worn by all workers in the work area. Provide a sufficient number for all required changes, for all workers in the work area.

*Boots:* Provide work boots with non-skid soles, and where required by OSHA, foot protectors, for all workers. Provide boots at no cost to workers. Paint uppers of all boots red with water proof enamel. Do not allow boots to be removed from the work area for any reason after being contaminated with asbestos containing material. Dispose of boots as asbestos contaminated waste at the end of the work.

*Hard Hats:* Provide head protectors (hard hats) as required by OSHA for all workers, and provide four spares for use by Owner's Representative, Project Administrator, and Visitors. Label hats with same warning labels as used on disposal bags. Require hard hats to be worn at all times that work is in progress that may potentially cause head injury. Provide hard hats of type with plastic strap type suspension. Require hats to remain in the work area throughout the work. Thoroughly clean, decontaminate and bag hats before removing them from work area at the end of the work.

*Goggles:* Provide eye protectors (goggles) as required by OSHA for all workers involved in scraping, spraying, or any other activity which may potentially cause eye injury.

*Gloves:* Provide work gloves to all workers and require that they be worn at all times in the work area. Do not remove gloves from work area. Dispose of gloves as asbestos contaminated waste at the end of the work.

*Safety Belts:* Provide safety belts for worker protection when workers are required to operate at heights and are not protected by other types of physical restraints.

ADDITIONAL PROTECTIVE EQUIPMENT:

Respirators, disposable coveralls, head covers, and footwear covers shall be provided by the Contractor for the Owner, Owner's Representative, Project Administrator, and other authorized representatives who may inspect the job site. Provide two respirators and six complete coveralls, and where applicable, six respirator filter changes per day.

## PART 3 - EXECUTION

*GENERAL:*

Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the work. The following procedures are minimums to be adhered to regardless of fiber count in the work area.

Each time work area is entered Remove all street clothes in the Changing Room of the Personnel Decontamination Unit and put on new disposable coverall, new head cover, and clean respirator. Proceed through shower room to equipment room and put on work boots.

DECONTAMINATION PROCEDURES:

Require all workers to adhere to the following personal decontamination procedures whenever they leave the work area:

Type C Supplied Air or Powered Air-Purifying Respirators: Require that all workers use the following decontamination procedure as a minimum requirement whenever leaving the work area:

When exiting area, remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the equipment room.

Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:

Thoroughly wet body including hair and face. If using a Powered Air-Purifying Respirator (PAPR) hold blower unit above head to keep canisters dry.

With respirator still in place thoroughly wash body, hair, respirator face piece, and all parts of the respirator except the blower unit and battery pack on a PAPR. Pay particular attention to seal between face and respirator and under straps.

Take a deep breath, hold in and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove respirator and hold it away from face before starting to breath.

Carefully wash facepiece of respirator inside and out.

If using PAPR: shut down in the following sequence: first cap inlets to filter cartridges, then turn off blower unit (this sequence will help keep debris which has collected on the inlet side of filter from dislodging and contaminating the outside of the unit). Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Be extremely cautious of getting water in battery pack as this will short out and destroy battery.

Shower completely with soap and water.

Rinse thoroughly.

Rinse shower room walls and floor prior to exit.

Proceed from shower to Changing Room and change into street clothes or into new disposable work items.

*Air Purifying-Negative Pressure Respirators*: Require that all workers use the following decontamination procedures as a minimum requirement whenever leaving the work area with a half or full face cartridge type respirator:

When exiting area, remove disposable coveralls, disposable head-covers, and disposable footwear covers or boots in the equipment room.

Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator and filters to avoid asbestos fibers while showering. The following procedure is required as a minimum:

Thoroughly wet body from neck down.

Wet hair as thoroughly as possible without wetting the respirator filter if using an air purifying type respirator.

Take a deep breath, hold it and/or exhale slowly, complete wetting of hair, thoroughly wetting face, respirator and filter (air purifying respirator). While still holding breath, remove respirator and hold it away from face before starting to breath.

Dispose of wet filters from air purifying respirator.

Carefully wash facepiece of respirator inside and out.

Shower completely with soap and water.

Rinse thoroughly.

Rinse shower room walls and floor prior to exit.

Proceed from shower to Changing Room and change into street clothes or into new disposable work items.

WITHIN WORK AREA:

Require that workers NOT eat, drink, smoke, chew gum or tobacco in the work area. To eat, chew, drink or smoke, workers shall follow the procedure described above, then dress in street clothes before entering the non-work areas of the building.

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT:

Following this section is a Certificate of Worker Training. After each worker has been included in the Contractor's Respiratory Protection Program, completed the training

program and medical examination, provide fully executed copy of this for to the Project Administrator.

END OF SECTION - II.A.11.

# CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

*DATE:*_____

*PROJECT NAME/NUMBER:*_____

*PROJECT ADDRESS:*_____

*CONTRACTOR'S NAME:* _____

*WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.*

Your employer's contract with the owner for the above project requires that: You be supplied with the proper respirator and be trained in its use. You have been trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These things are to have been done at no cost to you. By signing this certification you are assuring the owner that your employer has met these obligations to you.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. I have a copy of the written respiratory protection manual issued by my employer. I have been equipped at not cost with the respirator to be used on the above project.

TRAINING COURSE: I have been trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. The topics covered in the course include but were not limited to the following:

- Physical characteristics of asbestos
- Health hazards associated with asbestos
- Respiratory protection
- Use of protective equipment
- Negative air systems
- Work practices including hands on or on job training
- Personal decontamination procedures
- Air monitoring, personal and area
- Lock out Tag out

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months, which was paid for by my employer. This examination included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray.

*Signature*: _____

*Printed Name:*_____

*DSHS License #:*_____

*Witness:* _____

## 2.5. RESPIRATORY PROTECTION

II.A.12 - RESPIRATORY PROTECTION

PART I - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Instruct and train each worker involved in asbestos abatement or maintenance and repair of friable asbestos containing materials in proper respiratory use and require that each worker always wear a respirator, properly fitted on the face in the work area from the start of any operation which may cause airborne asbestos fibers until the work area is completely decontaminated. Use respiratory protection appropriate for the fiber level encountered in the work place or as required for other toxic or oxygen-deficient situations encountered.

STANDARDS:

Except to the extent that more stringent requirements are written directly into the Contract Documents, the following regulations and standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies were bound herewith. Where there is a conflict in requirements set forth in these regulations and standards, meet the more stringent requirements.

OSHA - U.S. Department of Labor Occupational Safety and Health Administration, Safety and Health Standards 29 CFR 1910, Section 1001 and Section 1910.134 CFR 1926.

CGA - Compressed Gas Association, Inc. New York, Pamphlet G-7, "Compressed Air for Human Respiration:, and Specification G-7.1 "Commodity Specification for Air"

CSA - Canadian Standards Association, Rexdal, Ontario, Standard Z180.1-1978, "Compressed Breathing Air".

ANSI - American National Standard Practices for Respiratory Protection, ANSI Z88.2-1980.

NIOSH - National Institute for Occupational Safety and Health

MSHA - Mine Safety and Health Administration

SUBMITTALS:

Before Start of Work, submit the following to the Project Administrator for review. Do not begin work until these submittals are returned with the Owner's Representative's action stamp indicating that the submittal are returned for unrestricted use.

*Product Data:* Submit manufacturer's product information for each component used, including NIOSH and MSHA Certifications for each component in an assembly and/or for entire assembly.

*System Diagram:* When a Type "C" supplied air respiratory system is required by the work, submit drawing showing assembly of components into a complete supplied air respiratory system. Include diagram showing location of compressor, filter banks, backup air supply tanks, hose line connections in work area(s), routing of air lines to work area(s) from compressor.

*Operating Instruction:* Submit complete operating and maintenance instructions for all components and systems as a whole. Submittals are to be in bound manual from suitable for field use.

*Respiratory Protection Program:* Submit level of respiratory protection intended for each operation required by the project. Submit this information on the "Respiratory Protection Program" form at the end of this section.

*Historic Airborne Fiber Data:* If the Contractor intends to use less respiratory protection for his personnel inside containment than that provided by Type "C", he must submit airborne asbestos fiber count data from an independent air monitoring firm to substantiate selection of respiratory protection proposed. Data submitted shall include at least the following for each procedure required by the work:

Date of measurements

Operation monitored, Detailed description of procedures used to remove the ACM

Sampling and analytical methods used and evidence of their accuracy.

Number, duration, Names of personnel performing work operation, and results of samples taken.

*Resume information:* Submit resume and information on training for individual monitoring the operation of supplied air respiratory systems. Submit training certifications where applicable.

AIR QUALITY FOR SUPPLIED AIR RESPIRATORY SYSTEMS:

Provide air used for breathing Type "C" supplied air respiratory systems that meets or exceeds standards set for C.G.A. type 1 (Gaseous Air)
Grade D:

ALLOWABLE CONTAMINANTS:
The following table sets forth the quality of any given contaminant allowed according to the referenced standards:

| GSA | Type 1 | (Gaseous Air) | | |
|---|---|---|---|---|
| CONTAINMENT | Grade D | Grade E | | Grade H |
| Carbon Monoxide, PPM/v | 20 | 10 | 5 | |
| Carbon Dioxide, PPM/v | 1000 | 500 | 500 | |
| Condensed Hydrocarbons, mg.cu. meter | 5 | 5 | 1 | |
| Gaseous Hydrocarbons - as methane, PPM/ | | 10 | | |
| Water Vapor - PPM/v | (1) | (1) | (1) | |
| dewpoint | 50F | 50F | 50F | |
| Objectional Odors | None | None | None | |
| Nitrogen Dioxide, PPM/v | - | - | 0.5 | |
| Nitrous Oxide, PPM/v | - | - | - | |
| Sulfur Dioxide, PPM/v | - | - | 0.5 | |
| Halogenated solvents, PPM/v | | - | 1 | |
| Other Gaseous Containments | | - | - | |
| Inorganic particulates, mg./cu. meter | - | - | - | |

- Indicates that the standard shows no limiting characteristics.

(1) The CGA standards do not specify moisture limit when the ambient temperature is above freezing. However, since a moisture content no greater than a -50 degrees Fahrenheit dewpoint (66 PPM/v) is necessary for carbon monoxide elimination, the CO limits could not be met unless the air were dried to a -50 Degrees Fahrenheit dewpoint or better.

(2) Maximum allowable content of tricholotrifluorethane, dicholorodifluor-omethane, and chlorodifuoromethane is 2 PPM/v for each. Unlisted contaminants shall not exceed one-tenth of the Threshold Limit Values (TLV's) for Chemical Substances in Workroom air adopted by the American Conference of Governmental Industrial Hygienists (ACGIH).

*DELIVERY:*

Deliver replacement parts, etc., not otherwise labeled by NIOSH or MSHA to job site in manufacturer's containers.

PART 2 - EQUIPMENT

AIR PURIFYING RESPIRATORS

*Respirator bodies:* Provide half face or full face type respirators. Equip full face respirators with a nose cup or other anti-fogging device as would be appropriate for use in air temperatures less than 32 degree Fahrenheit.

*Filter Cartridges:* Provide, at a minimum, HEPA type filters labeled with NIOSH and MSHA Certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists including Asbestos-Containing Dusts and Mists" and color coded in accordance with ANSI Z228.2 (1980). In addition, a chemical cartridge section may be added, if required, for solvents, etc., in use. In this case, provide cartridges that have each section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.

*Non-permitted respirators:* Do not use single use, disposable or quarter face respirators.

SUPPLIED AIR RESPIRATORS SYSTEMS:

Provide equipment capable of producing air of the quality and volume required by the above reference standards applied to the job site conditions and crew size. Comply with provisions of this specification if more stringent than the governing standard.

*Face piece and Hose:* Provide full face piece and hose by same manufacturer that has been certified by NIOSH/MSHA as an approved Type "C" respirator assembly operating in pressure demand mode with a positive pressure face piece.

*Back-up air supply:* Provide a reservoir of compressed air located outside the work area which will automatically maintain a continuous uninterruptible source of air automatically available to each connected face piece and hose assembly in the event of compressor shut-down, contamination of air delivered by compressor, power loss or other failure. Provide sufficient capacity in the back-up air supply to allow a minimum escape time of one-half hour times the number of connections is the air requirements of the respirators in use plus the air requirement of an average sized adult male engaged in moderately strenuous activity. The back-up air supply is not required if the face pieces being provided are all equipped with emergency back-up HEPA filter system including filter cartridges described above.

*Warning device:* Provide a warning device that will operate independently of the building's power supply. Locate so that alarm is clearly audible above the noise level produced by equipment and work procedures in use, in all parts of the work area and at

the compressor. Connect alarm to warn of:

Compressor shutdown or other fault requiring use of backup air supply, Carbon Monoxide (CO) levels in excess of 5 PPM/v. (Not required for oil-less compressors)

*Carbon Monoxide (CO) Monitor:* Continuously monitor and record on a strip chart recorder Carbon Monoxide levels. Place monitors in the air line between compressor and back-up air supply and between backup air supply and workers. Connect monitors to that they also sound an alarm as specified under " Warning Devices".

*Compressor Shut Down:* Interconnect monitors, alarms and compressor so that compressor is automatically shut down and the alarms sounded if any of the following occur:

Carbon Monoxide concentrations exceed 5 PPM/v in the air line between the filter bank and backup air supply,

Compressor temperature exceeds normal operating range.

*Compressor Motor:* - If desired, provide a compressor driven by an electric motor. Insure that electrical supply available at the work site is adequate to energize motor.

*Compressor Location:* Locate compressor outside of building in location that will not impede access to the building, and that will not cause a nuisance by virtue of noise of fumes to occupied portions of the building.

*Air Intake:* : Locate air intake remotely from any source of automobile exhaust or any exhaust from motors, or buildings.

*After Cooler:* Provide an after cooler at entry to filter system which is capable of reducing temperatures to outside ambient air temperatures.

*Self Contained Breathing Apparatus (SCBA):* Configure system to permit the recharging of 1/2 hour 2260 PSI SCBA cylinders.

PART 3 - EXECUTION

GENERAL:

*Respiratory Protection Program:* Comply with ANSI Z88.2 - 1980 "Practices for Respiratory Protection" and OSHA 29 CFR 1910 and 1926.

Require that respiratory protection be used at all times that there is any possibility of disturbance of asbestos-containing materials whether intentional or accidental.

Require that a respirator be worn by anyone in a work area at all times, regardless of

activity, during a period that starts with any operation which could cause airborne fibers until the area has been cleared for re-occupancy in accordance with Section II. A. 7.

*Regardless of Airborne Fiber Levels:* Require that the minimum level of respiratory protection used by half-face air-purifying respirators with high efficiency filters.

Do not allow the use of single-use, disposable, or quarter-face respirators for any purpose.

FIT TESTING:

*Initial Fitting:* Provide initial fitting of respiratory protection during a respiratory protection course of training set up and administered by a Texas licensed Consultant. Fit types of respirator to be actually worn by each individual. Allow an individual to use only those respirators for which he has been trained and fit.

*On a Weekly Basis*, check the fit of each worker's respirator by having irritant smoke blown onto the respirator from a smoke tube.

*Upon each Warning:* Require that each time an air purifying respirator is put on, it must be checked for fit with a positive and negative pressure fit test in accordance with the manufacturer's instructions or ANSI Z88.2 (1980).

TYPE OF RESPIRATORY PROTECTION REQUIRED:

Provide Respiratory Protection as indicated in paragraph below. Where paragraph below does not apply, determine the proper level of protection by dividing the expected or actual airborne fiber count in the work area by the "protection factors" given below. The level of respiratory protection which supplies an airborne fiber level inside the respirator, at the breathing zone of the wearer, at or below the permissible exposure limit (PEL) is the minimum level of protection allowed.

*Type "C" Supplied-air respirators:* full facepiece, pressure demand, supplied air respirators are to be used by all workers engaged in the removal, or demolition of pipes, structures, or equipment covered or insulated with asbestos, or in the removal or demolition of asbestos insulation or coverings, or any other activity which results in or may result in air borne fibers.

*Powered-air purifying respirators:* equipped with HEPA filters and tight fitting full facepieces or respirators with a higher NIOSH assigned protection factor may be used for inspection or repair work of a short duration or upon approval of the Project Administrator after review of the Contractor Proposed Respiratory Protection submittal.

*Negative Pressure (Half or Full Mask) Respirators:* shall only be utilized for preparatory work, final cleanup or bagout/disposal outside containment. They shall not be utilized during full containment removal work.

Any deviation from the above must have prior approval in writing by the Project Administrator.

PERMISSIBLE EXPOSURE LIMIT (PEL):

*8-Hour Time Weighted Average (TWA):* of asbestos fibers to which any worker may be exposed shall not exceed the following.

Time Weighted Average (TWA) - 0.1 fibers/cubic centimeter

*Fibers:* For purposes of this section fibers are defined as all fibers regardless of composition as counted in the OSHA reference Method (ORM), counted using a transmission electron microscope.

RESPIRATORY PROTECTION FACTOR:

| Respirator Type | Protection Factor |
|---|---|
| *Half facepiece*:<br>Air Purifying<br>Negative pressure respirator<br>High efficiency filter | *10* |
| *Full facepiece:*<br>Air purifying<br>negative pressure respirator<br>High efficiency filter | *10/50** |
| *Full facepiece Powered air purifying (PAPR):*<br>Positive pressure respirator<br>High efficiency filter | *1000* |
| *Half or Full facepiece:*<br>Type C supplied air<br>Positive pressure respirator<br>continuous flow | *100* |
| *Full facepiece:*<br>Type C supplied air<br>Positive pressure respirator<br>pressure demand | *1000* |

| Respirator Type | Protection Factor |
|---|---|
| Full facepiece:<br>Type C supplied air<br>Positive pressure respirator pressure demand<br>Equipped with an<br>auxiliary positive pressure<br>Self-contained breathing<br>apparatus (SCBA) | *over 1000* |
| Full facepiece:<br>Self-Contained breathing apparatus (SCBA)<br>Positive pressure respirator<br>Pressure demand | *over 1000* |

* Protection Factor is 10 if Qualitative Fit Testing is performed. PF= 50 if Quantitative Fit Testing is performed.

AIR PURIFYING RESPIRATORS:

*Negative pressure - half or full face mask:* Supply a sufficient quantity of respirator filters approved for asbestos, so that workers can change filters during the work day. Require that respirators be wet-rinsed, and filters discarded, each time a worker leaves the work area. Require that new filters be installed each time a worker re-enters the work area. Store respirators and filters at the job site in the changing room and protect totally from exposure to asbestos prior to their use.

*Powered air purifying - half or full face mask:* Supply a sufficient quantity or high efficiency respirator filters approved for asbestos so that workers can change filters at any time that flow through the facepiece decreases to the level at which the manufacturer recommends filter replacement. Require that regardless of flow, filter cartridges be replaced after 40 hours of use. Require that HEPA elements in filter cartridges be protected from wetting during showering. Require entire exterior housing of respirator, including blower unit, filter cartridges, hoses, battery pack, face mask, belt and cords to be washed each time a worker leaves the work area. Caution should be used to avoid shorting battery pack during washing. Provide an extra battery pack for each respirator so that one can be charging while one is in use.

TYPE "C" RESPIRATORS:
*Air Systems Monitor:* Continuously monitor the air system operation including compressor operation, filter system operation, backup air capacity and all warning and monitoring devices at all times that system is in operation. Assign an individual, trained by the manufacturer on the equipment in use or by a Texas licensed Consultant, in the operation and maintenance of the system to provide this monitoring. Assign no other duties to this individual which will take him away from monitoring the air system.

RESPIRATORY PROTECTION PROGRAM:

Submit completed form "Respiratory Protection Program" indicating type of respiratory protection proposed for each portion of the work.

END OF SECTION - II.A.12.

2.6. DECONTAMINATION UNITS

II.A.13. - DECONTAMINATION UNITS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Provide separate personnel and equipment decontamination facilities. Require that the Personnel Decontamination Unit be the only means of ingress and egress for the work area. Require that all materials exit
the work area through the Equipment Decontamination Unit.

RELATED WORK SPECIFIED ELSEWHERE:

Refer to II.A.8. Temporary Facilities - Asbestos Abatement for electrical requirements and requirements relative to connection of decontamination facilities to building systems such as water, sewer, and electrical.

PART 2 - PRODUCTS

*Polyethylene Sheet:* A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mm thick, clear, frosted, or black as indicated.

*Re-inforced Polyethylene Sheet:* Where plastic sheet is the only separation between the work area and building exterior, provide translucent, nylon reinforced, laminated, flame resistant, polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, minimum of 6.0 mm thick, frosted or black as indicated.

*Duct Tape:* Provide duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to aggressively stick to sheet polyethylene.

*Spray Cement:* Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

*Shower Pan:* Provide one piece waterproof shower pan 4' x 8' x 12" deep. Fabricate from seamless fiberglass minimum 1/16" thick reinforced with wood, 18 ga. stainless steel with welded seams, or a seamless liner of minimum 60 mil thick rubber roofing.

*Shower Walls:* Provide 8' long by approximately 7' high walls fabricated from rigid, impervious, waterproof material, either corrugated fiberglass roofing or equivalent. Structurally support as necessary for stability.

*Shower Head and Controls:* Provide a factory made shower head producing a spray of water which can be adjusted for spray size and intensity. Feed shower with water mixed from hot and cold supply lines. Arrange so that control of water temperature, flow rate, and shut off is from inside shower without outside aid.

*Filters:* Provide cascaded filter units on drain lines from showers or any other water

source carrying asbestos contaminated water from the work area. Provide units with disposable filter elements as indicated below. Connect so that discharged water passes primary filter and output of primary filter passes through secondary filter.

Primary filter - Pass particles 20 microns and smaller
Secondary Filter - pass particles 5 microns and smaller

*Hose Bib:* Provide heave bronze angle type with wheel handle, vacuum breaker, and 3/4" National Standard male hose outlet.

*Shower Stall:* For Wash Down Station provide leak tight shower enclosure with integrated drain pan fabricated from fiberglass or other durable waterproof material, approximately 3' x 3' square with minimum 6' high sides and back. Structurally support as necessary for stability. Equip with hose bib, as specified in this division, mounted at approximately 4' above drain pan. Connect drain to a reservoir, pump water from reservoir through filters to a drain or store and use for amended water. Mount filters inside shower stall on back wall beneath hose bib.

*Rubber Roofing:* Provide uniform flat sheets of flexible sheet roofing material fabricated from EPDM (ethylene propylene diene monomers) or Neoprene (polychloroprene), in a nominal thickness of 45 mm.

*Lumber:* Provide kiln dried lumber of any grade or species.

*Sump Pump:* Provide totally submersible waterproof sump pump with integral float switch. Provide unit sized to pump two times the flow capacity of all showers or hoses supplying water to the sump, through the filters specific herein when they are loaded to the extent that replacement is required. Provide unit capable of pumping debris, sand, plaster or other materials washed off during decontamination procedures without damage to mechanism of pump. Adjust float switch so that a minimum of 3" remains between top of liquid and top of sump pan.

## PART 3 - EXECUTION

### GENERAL:

### PERSONNEL DECONTAMINATION UNIT:

Provide a Personnel Decontamination Unit consisting of a serial arrangement of connected rooms or spaces, Changing Room, Shower Room, Equipment Room. Require all persons without exception to pass through this decontamination unit for entry into and exiting from the work area for any purpose. Do not allow parallel routes for entry or exit. Do not remove equipment or materials through Personnel Decontamination Unit. Provide temporary lighting within decontamination units as necessary to reach a lighting level of 100 foot candles.

*Changing Room (Clean Room):* Provide a room that is physically and visually separated from the rest of the building for the purpose of changing into protective clothing. Construct using polyethylene sheeting, at least 6mm in thickness, to provide an airtight seal between the Changing Room and the rest of the building. Locate so that access to Work Area from Changing Room is through Shower Room. Separate Changing Room from the building by a sheet polyethylene flapped doorway.

Require workers to remove all street clothes in this room, dress in clean disposable coveralls, and don respiratory protection equipment. Do not allow asbestos contaminated items to enter this room. Require workers to enter this room either from outside the structure dressed in street clothes, or naked from the showers. An existing room may be utilized as the Changing Room if it is suitably located and of a configuration whereby workmen may enter the Changing Room directly from the Shower Room. Protect all surfaces of room with sheet plastic as set forth in Division II.A.8. Temporary Enclosures. Authorization for this must be obtained from the Owner's Representative in writing prior to start of construction. Submit written request in accordance with Division II.A.14. Products and Substitutions detailing layout and protective measures proposed.

Maintain floor of changing room dry and clean at all times. Do not allow overflow water from shower to wet floor in changing room.

Damp wipe all surfaces twice after each shift change with a disinfectant solution.

Provide a continuously adequate supply of disposable bath towels.

Provide posted information for all emergency phone numbers and procedures.

Provide one elevated storage area per employee.

Provide all other components indicated on the contract drawings.

*Shower Room:* Provide a completely water-tight operational shower to be used for transit by cleanly dressed workers heading for the Work Area from the changing Room, or for showering by workers headed out of the Work Area after undressing in the Equipment Room.

Construct room by providing a shower pan and two shower walls in a configuration that will cause water running down walls to drip into pan. Install a freely draining wooden floor in shower pan at elevation of top of pan.

Separate this room from the rest of the building with air tight walls fabricated of 6 mil polyethylene.

Separate this room from the Changing and Equipment Rooms with two-flap overlapping doors fabricated of 6 mil polyethylene.

Provide splash proof entrances to Changing and Equipment Rooms with two doors arranged in the following configuration:

At each entrance to the Shower Room construct a door frame out of 2" x 4" lumber with 1 1/2" jambs (sides) and 1 1/2" head (top) and sill (bottom). Attach to this door frame two overlapping flaps of rubber roofing material, fastened at the head (top) and jambs (sides) (by clamping between a 1 1/2" x 3/4" batten and frame). Overlap the flaps a minimum of 6" in a direction that presents a shingle-like configuration to the water stream from the shower. Overlap sill (bottom) by 1 1/2" minimum. Arrange so that any air movement out of the Work Area will cause the flaps to seal against the door frame.

At 1' toward shower from each entrance to the Shower Room construct a second 2" x 4" door head (top). Attach to this door head a one piece flap of rubber roofing material, fastened at the top (by clamping between a 1 1/2" x 3/4" batten and head), overlapping onto each side of shower unit by 1 1/2" and stopping 1" clear of shower floor.

Provide shower head and controls.

Provide temporary extensions of existing hot and cold water and drainage, as necessary for a complete and operable shower.

Provide a soap dish and a continuously adequate supply of soap and maintain in sanitary condition.

Arrange so that water from showering does not splash into the Changing or Equipment Rooms.

Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the work area.

Provide flexible hose shower head.

Pump waste water to drain or to storage for use in amended water. If pumped to drain, provide 20 micron and 5 micron waste water filters in line to drain water storage. Change filters daily or more often if necessary. Locate filters inside shower unit so that water lost during filter changes is caught by shower pan.

Provide Hose Bib.

Provide all other items indicated on contract drawings.

*Equipment Room (contaminated area):* Require work equipment, footwear and

additional contaminated work clothing to be left here. This is a change and transit area for workers. Separate this room from the work area by a 6 mil polyethylene flap doorway.

Separate this room from the rest of the building with airtight walls fabricated of 6 mil polyethylene.

Separate this room from the Shower Room and Work Area with two flap doorway fabricated of 6 mil polyethylene.

*Work Area:* Separate work area from the Equipment Room by polyethylene barriers. If the airborne asbestos level in the work area is expected to be high, add an intermediate cleaning space between the Equipment room and the Work area. Damp wipe clean all surfaces after each shift change. Provide one additional floor layer of 6 mil polyethylene per shift change and remove contaminated layer after each shift.

Construction:

*Walls and Ceiling:* Construct airtight walls and ceiling using polyethylene sheeting, at least 6 mil in thickness. Attach to existing building components or a temporary framework.

*Floors:* Use two layers minimum of 6 mil. polyethylene sheeting to cover floors in the Equipment, Shower (underneath shower pan), and Changing rooms. Provide an additional layer in the Equipment Room for every shift change expected. Roll one layer of plastic from Equipment Room into Work Area after each shift change. Provide a minimum of two layers of plastic at all times. Use only clear plastic to cover floors.

*Doors:* Fabricated from overlapping sheets with openings a minimum of three feet wide. Configure so that sheeting overlaps adjacent surfaces. Weight sheets at bottoms as required so that they quickly close after being released. Put arrows on sheets to indicate direction of overlap and/or travel. Provide a minimum of six feet between entrance and exit of any room.

If the decontamination area is located within an area containing friable asbestos on overhead ceilings, ducts, piping, etc., provide the area with a minimum 1/4 inch hardboard or 1/2 inch plywood "ceiling" with polyethylene sheeting, at least 4 mil in thickness covering the top of the ceiling.

*Visual Barrier:* Where the decontamination area is immediately adjacent to and within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 4 mil in thickness so that worker privacy is maintained and work procedures are not visible to building occupants. Where the area adjacent to the decontamination area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with wood or metal studs covered with minimum 1/4 inch thick hardboard or 1/2 inch plywood. Where the solid barrier is provided,

sheeting need not be opaque.

*Alternate methods* of providing decontamination facilities may be submitted to the Consultant/Project Administrator for approval. Do not proceed with any such method(s) without written authorization of the Consultant/Project Administrator.

*Electrical:* Provide subpanel, complete with ground fault interrupter (GFI) switches, at Changing Room to accommodate all removal equipment. Power subpanel directly from a building electrical panel. Connect all electrical branch circuits in decontamination unit and particularly any pumps in shower room to a ground-fault circuit protection device.

DECONTAMINATION SEQUENCE:

*Entering Work Area:*

Worker enters Changing Room and removes street clothing, puts on clean disposable overalls and respirator, and passes through the Shower Room into the Equipment Room.

Any additional clothing and equipment left in Equipment Room needed by the worker are put on in the Equipment Room.

Worker proceeds to Work Area.

*Exiting Work Area:*

Before leaving the work area, require the worker to remove all gross contamination and debris from overalls and feet. The worker then proceeds to the Equipment Room and removes all clothing except respiratory protection equipment. Extra work clothing may be stored in contaminated end of the Equipment Room. Disposable coveralls are placed in a bag for disposal with other material. Decontamination procedures found in this section shall be followed by all individuals leaving the work area. After showering, the worker moves to the Changing Room and dresses in either new coveralls for another entry or street clothes if leaving.

EQUIPMENT DECONTAMINATION UNITS:
Provide an Equipment Decontamination Unit consisting of a serial arrangement of rooms, Clean Room, Holding Room, Wash Room for removal of equipment and material from work area. Contractor may submit alternates to the following to the Project Administrator for approval. Do not proceed with any such method(s) without written authorization of the Owner's Representative. Do not allow personnel to enter or exit Work Area through Equipment Decontamination Unit.

*Wash Down Station:* Provide an enclosed shower unit located in work area just outside Wash Room as an equipment, bag and container cleaning station.

*Wash Room:* Provide wash room for cleaning of bagged or containerized asbestos-containing waste materials passed from the work area. Construct wash room of 2"x 4" wood frame and polyethylene sheeting, at least 6 mil in thickness and located so that packaged materials, after being wiped clean can be passed to the Holding Room. Separate this room from the work area by a single flap of 6 mil polyethylene sheeting.

*Holding Room:* Provide Holding Room as a drop location for bagged asbestos-containing materials passed from the Wash Room. Construct Holding Room of 2"x 4"wood framing and polyethylene sheeting, at least 6mm in thickness and located so that bagged materials cannot be passed from the Wash Room through the Holding Room to the Clean Room. Separate this room from the adjacent rooms by double flaps fabricated from 1 1/6" (+/-) thick single ply rubber roofing material either EPDM or Neoprene.

*Clean Room:* Provide Clean Room to isolate the Holding Room from the building exterior. Construct Clean Room of 2"x 4" wood framing and polyethylene sheeting, at least 6 mil in thickness and locate to provide access to the Holding Room from the building exterior. Separate this room from the exterior by a single flap of 6 mil polyethylene sheeting.

*Equipment or Material:* Take all equipment or material from the work area through the Equipment Decontamination Unit according to the following procedure:

At wash down station, thoroughly wet-clean contaminated equipment or sealed polyethylene bags and pass into Wash Room.

When one is passing equipment or containers into the Wash Room, close all doorways of the Equipment Decontamination Unit, other than the doorway between the Wash down Station and the Wash Room. Keep all outside personnel clear of the Equipment Decontamination Unit.

Once inside the washroom, wet-clean the bags and/or equipment.
When cleaning is complete pass items into Holding Room. Close all doorways except the doorway between the holding Room and the Clean Room.

Workers from the building exterior enter Holding Area and remove decontaminated equipment and/or containers for disposal.
Require these workers to wear full protective clothing and appropriate respiratory protection.

At no time is a worker from an uncontaminated area to enter the enclosure when a removal worker is inside.

CLEANING OF DECONTAMINATION UNITS:

Clean debris and residue from inside of Decontamination Units on a daily basis or as

otherwise indicated on contract drawings. Damp wipe or hose down all surfaces after each shift change. Clean debris from shower pans on a daily basis.

If the Changing Room of the Personnel Decontamination Unit becomes contaminated with asbestos-containing debris, abandon the entire decontamination unit and erect a new decontamination unit. Use the former Changing Room as an inner section of the new Equipment Room.

*SIGNS:*

Post an approximately 20" x 14" manufactured caution sign at each entrance to the work area displaying the following legend with letter sizes and styles of a visibility required by 29 CFR 1926:

*LEGEND:*

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED
IN THIS AREA

Provide spacing between respective lines at least equal to the height of the respective upper line.

Post an approximately 10"x 14" manufactured sign at each entrance to each work area displaying the following legend with letter sizes and styles visibility at least equal to the following:

| LEGEND | NOTATION |
|---|---|
| No Food, Beverages or Tobacco Permitted | 3/4" Block |
| All Persons Shall Don Protective Clothing (Coverings) Before Entering the Work Area | 3/4" Block |
| All Persons Shall Shower Immediately After Leaving Work Area and Before Entering the Changing Area | 3/4" Block |

END OF SECTION - II.A.13.

2.7. PRODUCTS AND SUBSTITUTIONS

II.A.14. - PRODUCTS AND SUBSTITUTIONS - ASBESTOS ABATEMENT

PART 1 - GENERAL

Refer to Division 0 Procurement & Contracting Requirements for additional requirements.

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

*Definitions:* Definitions used in this paragraph are not intended to negate the meaning of other terms used in the contract documents, including such terms as, "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction" and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.

*"Products"* are items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "materials", "equipment", and "systems".

*"Named Products"* are products identified by use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in manufacturer's published product literature, of the latest issue as of the date of the contract documents.

*"Materials"* are products that must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form units of work.

*"Equipment"* is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

PROCEDURES:

*Substitutions:* The Contractor's requests for changes in the products, materials, equipment and methods of construction required by the contract documents are considered requests for "substitutions", and are subject to the requirement specified herein. The following are not considered as substitutions:

Revisions to the contract documents, where requested by the Owner, or Owner's Representative are considered as "changes" not substitutions.

Substitutions requested during the bidding period, which have been accepted prior to the Contract Date, are included in the contract documents and are not subject to the requirements for substitutions as herein specified.

Specified Contractor options on products and construction methods included in the contract documents are choices available to the Contractor and are not subject to the requirements for substitutions as herein specified.

Except as otherwise provided in the contract documents, the Contractor's determination of and compliance with governing regulations and orders as issued by governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.

*Standards:* Refer to Division-1 section "Definitions and Standards" for the applicability of industry standards to the products specified for the project, and for the acronyms used in the text of the specification sections.

QUALITY ASSURANCE:

*Source Limitations:* To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.

When it is discovered that specified products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Owner's Representative for a determination of what product qualities are most important before proceeding. The Owner's Representative will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Owner's Representative determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

*Compatibility of Options:* Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract documents, but must be provided by the Contractor.

SUBMITTALS:

Substitution Request Submittal:

*Requests for Substitutions:* Submit three copies of each request for substitution. In each request, identify the product or fabrication or installation method to be replaced by the substitution, include related specification section and drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include the following information, as appropriate, with each request:

Complete product data, drawings and descriptions of products, and fabrication and installation procedures.

Samples where applicable or requested.

A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities include elements such as size, weight, durability, performance and visual effect where applicable

Complete coordination information. Include all changes required in other elements of the work to accommodate the substitution, including work performed by the Owner and separate Contractor.

A statement indicating the effect the substitution will have on the work schedule in comparison to the schedule without approval of the proposed substitution Include information regarding the effect of the proposed substitution on the Contract Time.

Complete cost information, including a proposal of the net change, if any in the Contract Sum.

Certification by the contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the Contract documents, and that it will perform adequately in the application indicated.

Include in this certification, the Contractor's waiver of rights to additional payment or time, which may subsequently be necessary because of the failure of the substitution to perform adequately.

*Change Order Form:* Submit requests for substitutions in the form and in accordance with procedures required for change order proposals.

*Owner's Representative Action:* Within one week of receipt of the Contractor's request for substitution, the Owner's Representative will request additional information or documentation as may be needed for evaluation of the request. Within two weeks of receipt of the request, or within one week of receipt of the requested additional information or documentation, which ever is later, the Owner's Representative will notify the Contractor of either the acceptance or rejection of the proposed substitution.

Acceptance will be in the form of a change order.

Rejection will include a statement giving reasons for the rejection.

PRODUCT DELIVERY, STORAGE, AND HANDLING:

*General:* Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces. In particular coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.

PART 2 - PRODUCTS

GENERAL PRODUCT COMPLIANCE:

*General:* Requirements for individual products are indicated in the contract documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one of several different specifying methods, or in any combination of these methods. These methods include the following:

Proprietary
Descriptive
Performance
Compliance with Reference Standards

Compliance with codes, compliance with graphic details, allowances, and similar provisions of the contract documents also have a bearing on the selection process.

*Procedures for Selecting Products:* The Contractor's options in selecting products are limited by requirements of the contract documents and governing regulations. They are not controlled by industry and traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include but are not limited to the following for the various indicated methods of specifying:

*Non- Proprietary Specification Requirements:* Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with contract requirements.

*Or Equal:* Where some particular product or device is specified by brand name or

manufacturer it is to be considered a standard. If approved equal, items of other manufacture than those mentioned may be used, unless specifically noted otherwise for purpose of standardization. Any substitution must receive the written approval of the Owners Representative. In the specifications, many terms are preceded or followed by the phrase "or approved equal" and many other are not. The absence of that phrase is not to be interpreted as in derogation of the provisions of the paragraph. Comply with those contract document provisions concerning "substitutions" for obtaining owner's Representative's approval.

*Descriptive Specification Requirements:* Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand or trade name, provide products or assemblies that provide the characteristics indicated and otherwise comply with contract requirements.

*Performance Specification Requirements:* Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.

*Compliance with Standards, Codes, and Regulations:* Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.

*Visual Matching:* Where matching an established sample is required, the final judgment of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Owner's Representative. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of the contract documents concerning "substitutions" and "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.

*Visual Selections:* Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Owner's Representative is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.

*Allowances:* Refer to individual sections of the specifications and "Allowances" provisions in Division-1 sections for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.

SUBSTITUTIONS:

*Conditions:* The Contractor's request for a substitution will be received and considered when extensive revisions to the contract documents are not required, when the proposed changes are in keeping with the general intent of the contract documents, when the requests are timely, fully documented and properly submitted, and when one or more of the following conditions is satisfied, all as judged by the Owner's Representative. Otherwise, the requests will be returned without action except to record non-compliance with these requirements.

The Owner's Representative will consider a request for substitution where the request is directly related to an "or equal" clause or similar language in the contract documents.

The Owner's Representative will consider a request for substitution where the specified product or methods cannot be provided within the Contract Time. However, the request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or to coordinate the various activities properly.

The Owner's Representative will consider a request for substitution where the specified product or method cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

The Owner's Representative will consider a request for substitution where a substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting any offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Owner's Representative for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.

The Owner's Representative will consider a request for substitution when the specified product or method cannot be provided in a manner which is compatible with other materials of the work, and where the Contractor certifies that the substitution will overcome the incompatibility.

The Owner's Representative will consider a request for substitution when the specified product or method cannot be properly coordinated with other materials in the work, and where the Contractor certifies that the proposed substitution can be properly coordinated.

The Owner's Representative will consider a request for substitution when the specified product or method cannot receive a warranty as required by the contract documents and where the contractor certifies that the proposed substitution includes the required warranty.

*Work-Related Submittals:* The Contractor's submittal of and the Owner's Representative's acceptance of shop drawings, product data or samples which relate to work not complying with requirement of the contract documents, does not constitute an acceptable or valid request for a substitution, nor approval thereof.

GENERAL PRODUCT REQUIREMENTS:

Products that comply with the requirements of the contract documents that are undamaged and, unless otherwise indicated, unused at the time of installation. Provide products that are complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

*Standard Products:* Where they are available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

*Continued Availability:* Where, because of the nature of its application, the Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced products for which the manufacturer has published assurances that the products and their parts are likely to be available to the Owner at a later date.

*Name plate:* Except as otherwise indicated for required labels and operating date, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on the exterior of the completed project.

*Labels:* Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

PART 3 - EXECUTION:

INSTALLATION OF PRODUCTS:

General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated. Anchor each product securely in place,

accurately located and aligned with other work. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

END OF SECTION - II.A.14.

PART 3 - EXECUTION

3.1 PROJECT CLOSEOUT - ASBESTOS ABATEMENT

II.A.15. - PROJECT CLOSEOUT - ASBESTOS ABATEMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

*Definitions:* Project closeout is the term used to describe certain collective project requirements, indicating completion of the Work, that are to be fulfilled near the end of the Contract time in preparation for final acceptance and occupancy of the Work by the Owner, as well as final payment to the Contractor and the normal termination of the Contract.

Specific requirements for individual units of work are included in the appropriate sections of this Project Manual.

Time of closeout is directly related to "Substantial Completion"; therefore, the time of closeout may be either a single time period for the entire Work or a series of time periods for individual elements of the Work that have been certified as substantially complete at different dates. This time variation, if any, shall be applicable to the other provisions of this section.

PREREQUISITES TO SUBSTANTIAL COMPLETION:

*General:* Complete the following before requesting the Project Administrator/Consultant to inspect for certification of substantial completion, either for the entire Work or for portions of the Work. Include list of known exceptions.

In the progress payment request that coincides with, or is the first request following, the date substantial completion is claimed, show either 100% completion for the portion of the Work claimed as "substantially complete", or list incomplete

items, the value of incomplete work, and reasons for the Work being incomplete.

Include supporting documentation for completion as indicated in these contract documents.

Submit a statement showing an accounting of any changes to the Contract Sum.

Advise Owner of any pending insurance change-over requirements.

Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents as required.

Obtain and submit any required releases enabling Owner's full, unrestricted use of the Work and access to services and utilities. Where required, include occupancy permits, operating certificates and similar releases.

Complete final cleaning requirements, including touch-up painting of marred surfaces.

Touch-up and otherwise repair and restore marred exposed finishes.

*Inspection Procedures:* Upon receipt of Contractor's request for inspection, the Project Administrator/Consultant will either proceed with inspection or advise Contractor of unfulfilled prerequisites.

Following initial inspection, Project Administrator/Consultant will either prepare the certificate of substantial completion, or will advise Contractor of work which must be performed before the certificate will be issued. The Project Administrator/Consultant will repeat the inspection when requested and when assured that the Work has been substantially completed.

Results of the completed inspection will form the initial "punch-list" for final acceptance.

PREREQUISITES TO FINAL ACCEPTANCE:

*General:* Complete the following, as required, before requesting the Project Administrator/Consultant final inspection for certification of final acceptance, and final payment as required by the General Conditions. List known exceptions, if any, in request:

Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

Submit an updated final statement, accounting for any final additional changes to

the Contract Sum.

Submit a certified copy of the Project Administrator/Consultant's final punch-list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and has been endorsed and dated by the Project Administrator.

Submit consent of surety.

Submit a final liquidated damages settlement statement, acceptable to Owner.

Submit evidence of final, continuing insurance coverage complying with insurance requirements.

Re-inspection Procedure: The Project Administrator/Consultant will re-inspect the Work upon receipt of the Contractor's notice that the work, including punch-list items resulting from earlier inspections, has been completed.

Upon completion of re-inspection, the Owner's Representative will either prepare a certificate of final acceptance, or will advise the Contractor of work that is incomplete or of obligations that have not been fulfilled, but are required for final acceptance.

If necessary, the re-inspection procedure will be repeated.

RECORD DOCUMENT SUBMITTALS:

*General:* Specific requirements for record documents are indicated in the individual section of these specifications. Other requirements are indicated in the General Conditions. General submittal requirements are indicated in "submittals" sections.

Do not use any submitted record documents for Work purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to Contractor's record documents for the Owner's reference during normal working hours.

*Record Drawings:* Maintain a record set of contract drawings and shop drawings in a clean, undamaged condition. Mark-up the set of record documents to show the actual installation where the installed work varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing the actual "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross reference at the corresponding location on the working drawings. Give particular attention to concealed work that would be difficult to measure and record at a later date.

Mark record sets with red erasable pencil and, where feasible, use other colors to distinguish between variations in separate categories of work.

Mark-up new information which is known to be important to the Owner, but for some reason was not shown on either contract drawings or shop drawings.

Note related change-order number where applicable.

Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on cover of each set.

*Record Specifications:* Maintain one complete copy of the Project Manual, including specifications and addenda, and one copy of other written work documents such as change orders and similar modifications issued in printed form during work. Mark these documents to show substantial variations in the actual work performed in comparison with the text of the specifications and modifications as issued. Give particular attention to substitutions, selection of options and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product date, where applicable.

Upon completion of the Work, submit record specifications to the Owner's Representative for the Owner`s records.

*Record Product Data:* Maintain one copy of each product data submittal. Mark these documents to show significant variations in the actual Work performed in comparison with the submitted information. Include both variations in the products as delivered to the site, and variations from the manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark-up of record drawings and specifications.

Upon Completion of mark-up, submit complete set of record product data to the Owner's Representative for the Owner's records.

*Record Sample Submittal:* If applicable, immediately prior to date or dates of substantial completion, the Contractor will meet at the site with the Owner's Representative and the Owner's personnel, if desired, to determine which, if any, of the submitted samples that have been maintained by the Contractor during progress of the Work, are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's sample storage space.

*Miscellaneous Record Submittals:* Refer to other sections of these specifications for requirements of miscellaneous record keeping and submittals in connection with the actual performance of the Work. Immediately prior to the date or dates of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Project Administrator/Consultant for the Owner's records.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

FINAL CLEANING:

*General:* Special cleaning requirement for specific units of Work are included in the appropriate sections of this Project Manual. General Cleaning during the regular progress of the Work is required by the General Conditions and is included under section "Temporary Facilities."

*Cleaning:* Provide final cleaning of the Work at the time indicated. Employ experienced workers or professional cleaners for final cleaning. Comply with the manufacturer's instructions for operations.

Complete the following cleaning operations before requesting the Project Administrator/Consultant's inspection for certification of substantial completion.

Remove exposed labels in finished spaces which are not required as permanent labels on materials supplied as part of the work, except for "Asbestos", "Asbestos Free", or Thermal Insulation Labels specified elsewhere.

Clean transparent materials affected by the work, including mirrors and window/door glass, to a polished condition, removing substances which are noticeably vision-obscuring materials. Replace broken glass and damaged transparent materials.

If required by Owner, wax and polish (2 coats) hard surfaced floors using materials supplied by the Owner.

Clean exposed hard-surfaced finishes affected by the work, to a dirt free condition, free of dust, stains, films and similar distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of surfaces. Restore reflective surfaces to original reflective condition.

Vacuum clean with HEPA vacuum carpeted surfaces and similar soft surfaces and/or professionally clean to remove staining caused by work of this contract.

Clean plumbing fixtures affected by the work to a sanitary condition, free of stains including those resulting from waste exposure.

Replace all HVAC Filters using materials supplied by Owner or clean non-replaceable filters after minimum of two dates of operation of HVAC equipment.

Clean light fixtures and lamps which have been affected by the work so as to function with full efficiency. Replace lamps where inoperable.

Clean project site (yard and grounds), including landscaped areas, of litter and foreign substances left during the course of the work. Sweep paved areas which have been effected by the Work to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits left by the Work. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface where they have been disturbed by the work.

*Removal of Protection:* Except as otherwise indicated or requested by the Owner's Representative, remove temporary protection devices and facilities which were installed during the course of the Work to protect previously completed work during the remainder of the construction period.

*Compliances:* Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at the site. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile or other harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

Where extra materials of value remaining after completion of associated work have become the Owner's property, dispose of these to the Owner's best advantage as directed.

END OF DIVISION - II.A.- 15.

# CERTIFICATION OF PROJECT COMPLETION

*Project Name/Number:* _____*Date:*_____
*Containment*
*Name/Number:*_____
(Designate Containment)

In accordance with Section II. A. 15 "Project Closeout" the Contractor hereby certifies that he has complied with all closeout procedures including final paperwork requirements for the above referenced project.

*Designated Signatory:*_____*Date:* _____

*(Print Name):* _____

*(Print Title):*_____*DSHS License #:*_____

# PROJECT CONSULTANT CERTIFICATION

The Project Administrator hereby certifies that he has verified Contractor's compliance with closeout procedures; verified final paperwork requirements and to the best of his knowledge and belief, the contractor's certification above is a true and honest one.

*Designated Signatory:*_____*Date:* _____

*(Print Name):* _____

*(Print Title):*_____*DSHS License #:*_____

3.2. PROJECT DECONTAMINATION

II.A.16. - PROJECT DECONTAMINATION

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

*General:* Decontamination of the Work Area following asbestos abatement.

If the asbestos abatement work is on damaged or friable materials, then this is deemed contaminated before start of the work and in need of decontamination. In this case the work is a four step procedure with two cleansing of the primary barrier plastic prior to its removal and two cleansings of the room surfaces to remove any existing contamination.

If the asbestos abatement work is on undamaged and non-friable materials, then the work area is deemed uncontaminated before start of the work. The decontamination procedure in this case is a two step procedure with two cleansings of the primary barrier plastic to remove contamination, thus preventing contamination of the area outside of the work area when isolation barriers are removed.

In either case, operation of the negative pressure system will be used to remove airborne fibers generated by the abatement work.

*Removal of Barriers:* Approval of the Project Administrator is required prior to the removal of any Primary or Critical Barriers.

RELATED WORK SPECIFIED ELSEWHERE:

*Removal of Gross Debris:* is integral with the performance of abatement work and as such is specified in the appropriate work section(s) of these specifications:

II.B.1. Removal of Asbestos Containing Materials

*Work Area Clearance:* Air testing and other requirements which must be met before release of Contractor and re-occupancy of the work area are specified in Division II.A.17.-1

PART 2 - PRODUCTS

Encapsulant: Certane 1000 or equal.

PART 3 - EXECUTION

GENERAL:

*Work of This Section:* includes the decontamination of air in the Work Area which has been, or may have been contaminated by the elevated airborne asbestos fiber levels generated during abatement activities, or which may previously have had elevated fiber levels due to friable asbestos containing materials in the space.

*Work of This Section:* includes the cleaning, decontamination, and removal of temporary facilities installed prior to abatement work, including:

Primary and Critical barriers erected by work of II.A.10.

Decontamination Unit erected by work of II.A.13.

Negative Pressure System installed by work of II.A.9.

*Work of This Section:* includes the cleaning, and decontamination of all surfaces (ceiling, walls, floor) of the Work Area, and all furniture and equipment in the Work Area.

START OF WORK:

*Previous Work:* During completion of the asbestos abatement work specified in other sections, the Drop Cloth of polyethylene sheeting on the floor will have been removed and disposed of along with any gross debris generated by the asbestos abatement work.

*Start of Work:* Work of this section begins with the cleaning of the Primary Barrier. At start of work the following will be in place:

Primary Barrier: Two layers of polyethylene sheeting on floor and two layers on walls as required.

Critical Barrier which forms the sole barrier between the work area and other portions of the building or the outside.

Critical Barrier Sheeting over lighting fixtures, ventilation openings, doorways, convectors, and other openings.

Decontamination Units for personnel and equipment in operating condition.

Negative Pressure System in operation.

FIRST CLEANING:

*First Cleaning:* Carry out a first cleaning of all surfaces of the work area including items of remaining sheeting, tools, scaffolding and/or staging by use of damp-cleaning and mopping, and/or a High Efficiency Particulate Absolute (HEPA) filtered vacuum.

*First Cleaning: (cont'd)*

(Note: A HEPA vacuum will fail if used with wet materials). Do not perform dry dusting or dry sweeping. Use each surface of a cleaning cloth one time only and then dispose of as contaminated waste. Remove initial layer of Primary Barrier and clean remaining layer. Continue this cleaning until there is no visible debris from removed materials or residue on plastic sheeting or other surfaces.

*Remove All Pre-Filters in Negative Air System(s):* and dispose of as asbestos containing waste in accordance with requirements of Section II. A. 09.

*Wait Overnight (minimum 8 hours):* to allow negative air machines to clean air of airborne asbestos fibers. Use fans as necessary to assure circulation of air in all parts of work areas during this period. Maintain negative pressure system in operation for the entire period.

*Encapsulation:* Perform encapsulation where required at this time. Maintain negative air system in operation during encapsulation work. Complete and submit to Project Administrator the Certification of Encapsulation form at the end of this Section.

If area was considered uncontaminated prior to Work beginning, omit the Second and Third cleaning and proceed with Final Cleaning.

SECOND CLEANING:

*Second Cleaning:* Carry out a second cleaning of all surfaces in the work area in the same manner as the first cleaning.

Immediately following the second cleaning of the primary plastic, remove the remaining layer of Primary Barrier sheeting and Material Decontamination Unit, if there is one, leaving only:

Critical Barrier: which forms the sole barrier between the work area and other portions of the building or the outside.
Critical Barrier Sheeting: over lighting fixtures, ventilation openings, doorways, convectors, and other openings.
Decontamination Unit: for personnel is in operating condition.
Negative Pressure System: maintain in continuous operation.

THIRD CLEANING:

*Third Cleaning:* Carry out a third cleaning of all surfaces in the work area in the same manner as the first cleaning immediately after removal of primary plastic. This cleaning is now being applied to existing room surfaces. Take care to avoid water marks or other damage to surfaces.

*Wait Overnight (8 hours minimum):* to allow negative air machines to clean air of airborne asbestos fibers. Use fans as necessary to assure circulation of air in all parts of work areas during this period. Maintain negative pressure system in operation for the entire period.

FINAL CLEANING:

*Final Cleaning:* Carry out a final cleaning of all surfaces in the work area in the same manner as the previous cleaning.

*Wait Overnight (8 hours minimum):* to allow negative air machines to clean air of airborne asbestos fibers Use oscillating fans as necessary to assure circulation of air in all parts of work areas during this period. Maintain negative pressure system in operation for the entire period.

VISUAL INSPECTION:

*After Waiting Period Perform a Complete Visual Inspection* of the entire work area including: decontamination unit, all remaining plastic sheeting, seals over ventilation openings, doorways, windows, and other openings; look for debris from any sources, residue on surfaces, dust or other matter. If any such debris, residue, dust or other matter is found, repeat final cleaning and continue decontamination procedure from that point. When the area is visually clean, complete the certification at the end of this section. Visual inspection is not complete until confirmed in writing, on the certification, by Project Administrator.

FINAL AIR SAMPLING:

*Phase Contrast Microscopy (PCM):* After the work area is found to be visually clean, air samples will be taken and analyzed in accordance with the procedure for Phase Contrast Microscopy set for in II.A.17.:

> If Release Criteria is not met, repeat Final Cleaning and continue decontamination procedure from that point.
>
> If Release Criteria is met, remove the Critical Barriers (Remaining layer of primary plastic and Critical Barriers if work area was considered not contaminated) separating the work area from the rest of the building and shut down and remove the negative pressure system.

COMPLETION OF ABATEMENT WORK:

*Seal negative air machines* with 6 mil polyethylene sheet and duct tape to form a tight seal at intake end before being moved from work area.

*Asbestos Abatement Work is Complete:* upon meeting the work area clearance criteria and fulfilling the following:

Remove all equipment, materials, debris from the work site.

Dispose of all asbestos containing waste material as specified in II.B.2.

Repair or replace all interior finishes damaged during the course of asbestos abatement work.

Fulfill Project Closeout Requirements of Section II. A. 15.

CERTIFICATE OF VISUAL INSPECTION:

Following this section is a "Certificate of Visual Inspection". This certification is to be completed by the Contractor and certified by the Project Administrator. Submit completed certificate with application for final payment. Final payment will not be made until this certification is executed.

END OF SECTION - II.A.16.

# CERTIFICATION OF VISUAL INSPECTION

*Project Name/Number:* _____*Date:* _____

*Containment Name/Number:*_____
(Designate Containment)

In accordance with II.A.16. "Project Decontamination" the Contractor hereby certifies that he has visually inspected the work area (all surfaces including pipes, beams, ledges, walls, ceiling, and floor, Decontamination Unit, sheet plastic, etc.) and has found not dust, debris or residue.

*Designated Signatory:* _____ *Date:*_____

*Print Name:* _____

*Title:*_____*DSHS License #:*_____

# PROJECT ADMINISTRATOR CERTIFICATION OF VISUAL INSPECTION

The Project Administrator hereby certifies that he has accompanied the Contractor on his visual inspection and verifies that this inspection has been thorough and to the best of this knowledge and belief, the Contractor's certification above is a true and honest one.

*Designated Signatory:* _____*Date:*_____

*Print Name:* _____

*Title:*_____*DSHS License #:*_____

# CERTIFICATION OF ENCAPSULATION INSPECTION

*Project Name/Number: -_____Date:_____*

*Containment Name/Number:_____*
(Designate Containment)

In accordance with the Project Manual for on the above mention project the Contractor certifies that he/she has inspected the containment area and has found that he/she has properly and securely encapsulated all substrates and items that had asbestos-containing material removed from them in this work area as required by the Project Manual.

*Designated Signatory: _____ Date:_____*

*Print Name: _____*

*Title:_____ DSHS License #:_____*

## PROJECT ADMINISTRATOR'S CERTIFICATION OF ENCAPSULATION INSPECTION

The Project Administrator hereby certifies that he has accompanied the Contractor on his visual inspection and verifies that this inspection has been thorough and to the best of his knowledge and belief, the Contractor's certification above is a true and honest one.

*Designated Signatory: _____ Date:_____*

*Print Name: _____*

*Title:_____DSHS License #:_____*

3.3. WORK AREA CLEARANCE

II.A.17. - WORK AREA CLEARANCE

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

CONTRACTOR RELEASE CRITERIA:

The Work is Complete when the work area is visually clean and airborne fiber levels have been reduced to 0.10 f/cc by (PCM) or <70 s/mm2 by TEM. All these tasks will be carried out by the Project Manager under the direction of the Project Administrator/Consultant. The Project Organizational Breakdown is found in SECTION I. A. page 1

AIR MONITORING:

To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the Owner's Consulting Agency/Laboratory, will secure samples and analyze them according to the following procedures.

*Fibers Counted:* "Fibers" referred to in this section shall be either all fibers regardless of composition as counted in the P&CAM 239, NIOSH 7400, or OSHA Reference Method Procedures or asbestos fibers of any size as counted using a Transmission Electron Microscope.

AGGRESSIVE SAMPLING:

All Air Samples will be taken using aggressive sampling techniques as follows:

There are not standards available for flow rate of leaf blowers or large fans. However this information is not critical to the success of the procedure.

Before sampling pumps are started the exhaust from forced air equipment (leaf blower with at least 1 horsepower electric motor) will be swept against all walls, ceilings, floors, ledges and other surfaces in the room. This procedure will be continued for 5 minutes per 10,000 cubic feet of room volume.

Air samples will be collected in areas subject to normal air circulation away from room corners, obstructed locations, and sites near windows, doors or vents.

SCHEDULE OF FINAL CLEARANCE SAMPLES:

*General:* The number and volume of area air samples taken and analytical methods used by the air monitor will be in accordance with the following schedule. Sample volumes given may vary depending upon the analytical instrument used.

PHASE CONTRAST MICROSCOPY (PCM) AREA CLEARANCE SAMPLES:

In each homogeneous work area after completion of all cleaning work, clearance samples will be taken and analyzed as follows:

| Location (Area Samples) | Number Rate Volume Samples | Filter of LPM Fibers/cc | Limit of Media (Liters) | Recommended Quantifications | |
|---|---|---|---|---|---|
| Inside Work Area | 2-10 | 5 | MCE | 0.005 | 1250 to 2950 |
| Outside Each Work Area | 2-10 | 0 | MCE | 0.005 | 1250 to 2950 |
| Outside Building | 2-10 | 0 | MCE | 0.005 | 1250 to 2950 |
| Field Blank | 2 | MCE | 0 | 0 | |
| Sealed Blank | 10 | MCE | One sample analyzed per box | | |

* A minimum of three (3) samples will be collected per containment.

*NOTE:* the Mixed Cellulose Ester filter shall be analyzed by Phase Contrast Microscopy by NIOSH 7400 Method A rules (25mm cassettes).

Decontamination of the work site is complete when every work area sample is below the Detection Limit above. If any sample is above the Detection Limit then the decontamination is incomplete and recleaning is required. All clearance samples must be below .010 fibers per cubic centimeter (f/cc) if cleared by PCM and below 70 structures per millimeter squared (s/mm2) if cleared by TEM.

LABORATORY TESTING:

A Phase Contrast microscope and technician will be setup at the job site, or samples will be sent daily to the laboratory so that verbal reports on area air samples can be obtained within 24 hours and/or the time frame stipulated by the building Owner or the Owner's representative. A complete record, certified by the testing laboratory, of all air

monitoring tests and results will be furnished to the Owner's Representative, the Owner and the Contractor.

3.4. REMOVAL OF ASBESTOS - ASBESTOS CONTAINING MATERIALS

II.B.1. - REMOVAL OF ASBESTOS-CONTAINING MATERIALS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

RELATED WORK SPECIFIED ELSEWHERE:

Installation of Critical and Primary Barriers, and work area isolation procedures are set forth in Section II.A.10.

Project Decontamination procedures after removal of the barriers are specified in Section II.A.13.

Disposal of asbestos-containing waste is specified in Section II.B.2.

SUBMITTALS:

*Before Start of Work:* Submit the following as required to the Owner's Representative for review. Do not start work until these submittals are returned with Owner's Representative's action stamp indicating that the submittal is returned for unrestricted use.

*Surfactant:* Submit product data, use instructions and recommendations from manufacturer of surfactant intended for use. Include data substantiating that material complies with requirements.

*Encapsulant:* Submit product data, use instructions and recommendations from manufacturer of encapsulant intended for use. Include data substantiating that material complies with requirements.

> NESHAPS Certification: Submit certification from manufacturer of surfactant or removal encapsulant that, to the extent required by this specification, the material, if used in accordance with manufacturer's instructions, will wet asbestos containing materials to which it is applied as required by the National Emission Standard for Hazardous Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, subpart M).

*Material Safety Data Sheet:* Submit the Material Safety Data Sheet, or equivalent, in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200) for each surfactant and encapsulating material proposed for use on the work. Include a separate attachment for each sheet indicating the specific worker protective equipment proposed for use with the material indicated.

PART 2 - PRODUCTS:

Wetting Materials: For wetting prior to disturbance of asbestos-containing materials use either water or a removal encapsulant:

> *Amended Water:* Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the asbestos containing material equal to or greater than that provided by the use of one ounce of surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

*Polyethylene Sheet:* A single polyethylene film in the largest sheet size possible to minimize seams, 4.0 or 6.0 mm thick as indicated, clear, frosted, or black as indicated.

*Duct Tape:* Provide duct tape in 3" widths as required, with an adhesive which is formulated to aggressively stick to sheet polyethylene. 2" duct tape may be substituted for use outside containment.

*Spray Cement:* Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

*Disposal Bags:* Provide 6 mil thick leak-tight polyethylene bags labeled with text in accordance with 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING AIRBORNE ASBESTOS, TREMOLITE, ANTHOPHYLITE, OR ACTINOLITE FIBERS IS HAZARDOUS TO YOUR HEALTH

Additionally the bags shall be labeled in accordance with the U.S. Department of Transportation requirements on hazardous waste marking, 49 CFR Part 171 and 172, Hazardous Substances: Final Rule. Label to read:

RQ ASBESTOS MIXTURE
NA2212
Class 9 Hazard Label

No Placard

*Disposal Drums:* Provide fiberboard or metal disposal drums with locking rims. Label drums in same manner as disposal bags.

PART 3 - EXECUTION

DROP CLOTH

*Drop Cloth:* Over the Primary Barrier, install as a drop cloth a clear 6 mil sheet plastic in all areas where asbestos removal work is to be carried out. Completely cover floor with sheet plastic. Where the work is within 10' of a wall extend the drop cloth up wall a minimum of 12 inches. Support sheet plastic on wall with duct tape. Seal top of drop plastic to primary barrier with duct tape so that debris is unable to get behind it. Provide cross strips of duct tape at wall support as necessary to support sheet plastic and prevent its falling during removal operations.

*Install:* drop cloth at beginning of each work shift. Install only sufficient plastic for work of that shift.

*Remove:* drop cloth at end of each work shift or as work in an area is completed. Fold plastic toward center of sheet and pack in disposal bags. Keep material on sheet continuously wet until bagging.

*Install Walkways:* of black 6 mil plastic between active removal areas and decontamination units to protect Primary layer from tracked material. Install walkways at the beginning of, and remove at, the end of each work shift.

WORKER PROTECTION:

Before beginning work with any material for which a Material Safety Data Sheet has been submitted provide workers with the required protective equipment. Require that appropriate protective equipment be used at all times.

WET REMOVAL:

Thoroughly wet to satisfaction of Project Administrator, asbestos- containing materials to be removed prior to stripping and/or tooling to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal encapsulant.

Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for water or removal encapsulant to penetrate material thoroughly. If amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. If a removal encapsulant is used, apply in strict accordance with manufacturer's written instructions. Perforate outer covering of any installation which has been painted and/or jacketed in order to allow penetration of

amended water or removal encapsulant, or where necessary, carefully strip away while simultaneously spraying amended water or removal encapsulant on the installation to minimize dispersal of asbestos fibers into the air.

Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.

Remove saturated asbestos-containing material in small sections from all areas. Do not allow material to dry out. As it is removed, simultaneously pack material while still wet into disposal bags. Twist neck of bags, seal with duct tape, bend over (gooseneck) and seal with minimum three wraps of duct tape ensuring that loose ends of disposal bag are contained in the wrap. Clean outside and move to washdown station adjacent to material decontamination unit.

Evacuate air from disposal bags with a HEPA filtered vacuum cleaner before sealing.

*Pipe Insulation:* Spray with a mist of amended water or removal encapsulant. Allow amended water or removal encapsulant to saturate material to substrate. If a removal encapsulant is used, use in strict accordance with manufacturer's instructions. Cut bands holding preformed pipe insulation, slit jackets at seams, remove and hand place in a disposal bag. Remove job molded fitting insulation in chunks and hand place in a disposal bag. Do not drop to floor. Remove any residue on pipe or fitting with stiff bristle nylon hand brush. In locations where pipe fitting insulation is removed from pipe with straight runs insulated with fibrous glass or other non-asbestos containing fibrous material, remove fibrous material 6" from the point where it contacts the asbestos-containing insulation.

LOCAL EXHAUST VENTILATION AND COLLECTION SYSTEM:

Provide local exhaust ventilation and collection systems as described below for each area where amosite asbestos-containing material is being removed or otherwise disturbed:

*Provide Negative Air Machine:* in addition to those required by II.A.9., in the vicinity of work. Arrange so that the machine is exhausting to the outside environment whenever possible. Extend a 12" diameter flexible non-collapsing duct from the intake end to a point no more than 4'-0" from any scraping or wire brushing activity.

Locate intake of duct so that air flow is horizontally and slightly downward into intake. Replace primary filter on negative air machine at an interval of no greater than 30 minutes. Allow no more than one scraping or wire brushing activity per negative air machine.

Attach a job built 4' x 4' flared end piece on intake end of duct. Support end piece horizontally at a point 4'-0" below the work, so that airflow is downward into intake.

AIRBORNE FIBER COUNTS:

*General:* Use work procedures that result in an Eight hour Time Weighted Average (TWA) airborne fiber count less than that indicated in the section of the specifications on "Air Monitoring - Test Laboratory Services". If airborne fiber counts exceed this level immediately mist the area with amended water to lower fiber counts and revise work procedures to maintain airborne fiber levels within the required limit.

END OF SECTION - II.B.1.

3.5. DISPOSAL OF ASBESTOS - ASBESTOS CONTAINING WASTE MATERIAL

II.B.2. - DISPOSAL OF ASBESTOS-CONTAINING WASTE MATERIAL

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DISPOSAL:

All the asbestos waste and contaminated materials must be disposed of in a Texas licensed landfill.

Friable asbestos-containing waste material and debris which are packaged in accordance with the provisions of this Specification may be disposed of at sanitary landfills licensed to accept asbestos waste when all state and federal procedures are followed.

The contractor will provide a TEXAS COMMISSION on ENVIRONMENTAL QUALITY (TCEQ) UNIFORM HAZARDOUS WASTE MANIFEST to accompany all ACM waste generated from this removal project. This manifest must be executed in every phase of the transport, storage and disposal of the ACM. The execution of the waste manifest will be performed and coordinated by the Project Administrator or Project Manager and the Contractors Project Superintendent or Project Supervisor.

If applicable, the Contractor will perform the following:

Notice to Appropriate Environmental Protection Agency regional office.

Notice and Permit from Appropriate State and/or Local Agencies.

See Section II. A. 4. for Agency Locations and Codes

Dispose of non-friable asbestos containing materials in accordance with applicable regulations.

SUBMITTALS:

Submit copies of all manifests and landfill receipts to the Project Administrator within 24 hours of dispatching a load of ACM to the disposal site.

*PART 2 - PRODUCTS (NOT APPLICABLE)*

*PART 3 - EXECUTION*

GENERAL:

The Contractor will provide a minimum of 24 hour advance notice to the Project Administrator prior to departure of any ACM to the landfill.

The Contractor will ensure the following procedures are adhered to as a minimum:

Label all bags, containers and pipe wrappings with the date, name, address (city/state) and phone number of the property and building owner. This label must be placed on all waste disposed of from this project.

Ensure that all disposal bags which contain solid wastes, ie; support systems of thermal insulation, aluminum cladding or any materials which might puncture the disposal bags, are disposed of in properly labeled sealed fiber drums.

Carefully load containerized waste on sealed trucks or other appropriate vehicles for transport. Exercise care before and during transport, to insure that no unauthorized persons have access to the material.

Do not store disposal-bagged material outside of the work area. Take bags from work area directly to a sealed truck or dumpster. All material will be transported directly from the jobsite to the disposal site.

Do not transport disposal-bagged materials on open trucks. Double bagged material may be transported on open trucks if they are first loaded in sealed drums. Label drums with same warning labels as bags. Uncontaminated drums may be reused. Treat drums that have been contaminated as asbestos-containing waste and dispose of in accordance with this specification.

Advise the sanitary landfill operator, at least twenty-four hours in advance of transport, of the quantity of material to be delivered.

At the burial site, sealed plastic bags will be carefully unloaded from the truck. If bags are broken or damaged, leave in the truck and clean entire truck and contents using procedures set forth in II.A.16. Project Decontamination.

Retain receipts from landfill for materials disposed of and return to the Project Administrator.

END OF SECTION 02 82 00